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UNITED STATES ARMY,

TO THE

SECRETARY OF WAR,

FOR

THE YEAR 1885.

IN FOUR PARTS.

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Bridge across Detroit River between Belle Isle and the American shore, 1917; bridge across Willamette River at Portland, Oreg., 1918; bridge across the Monongahela River near Fairmont, W. Va., 1919; bridge of the Northern Pacific Railroad Company across Saint Louis River, Minn. and Wis., 1925.

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REPORT OF MAJ. CHARLES J. ALLEN, CORPS OF ENGINEERS.

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Examinations and Surveys.—Big Stone Lake and Lake Traverse, Minn., with a view to connecting them, 1951; Agate and Burlington bays, Minn., 1954; Saint Louis Bay and Saint Louis River, from Connor's Point, Wis., and Rice's Point, Minn., to foot of first falls, 1959.

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REPORT OF LIEUT. COL. J. W. BARLOW, CORPS OF ENGINEERS.

Improvements.—Ontonagon Harbor, Mich., 1968; Eagle Harbor, Mich., 1970; Marquette Harbor, Mich., 1971; harbor of refuge at Grand Marais, Mich., 1973; Manistique Harbor, Mich., 1974; harbor at mouth of Cedar River, Mich., 1976; Menomonee Harbor, Mich. and Wis., 1978; Oconto Harbor, Wis., 1982; Pensaukee Harbor, Wis., 1985; Green Bay Harbor, Wis., 1987; harbor of refuge at entrance of Sturgeon Bay Canal, Wis., 1988; Ahnepee Harbor, Wis., 1989; Kewaunee Harbor, Wis., 1993; Two Rivers Harbor, Wis., 1995; Manitowoc Harbor, Wis., 1998; Sheboygan Harbor, Wis., 2001; Port Washington Harbor, Wis., 2003.

Examinations and Surveys.—Lac la Belle Harbor, Mich., 2005; Ashland Harbor, Lake Superior, Wis., 2010.

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Improvements—Harbor of refuge, Milwaukee Bay, Wis., 2015; Milwaukee Harbor, Wis., 2018; Racine Harbor, Wis., 2019; Kenosha Harbor, Wis., 2021; Waukegan Harbor, Ill., 2023; Fox and Wisconsin rivers, Wis., 2025.

APPENDIX J J.

REPORT OF MAJ. W. H. H. BENYAURD, CORPS OF ENGINEERS.

Improvements.—Chicago Harbor, Ill., 2047; Calumet Harbor, Ill., 2051; Illinois River, 2052; Calumet River, 2055.

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REPORT OF CAPT. D. W. LOCKWOOD, CORPS OF ENGINEERS.

Improvements.–Charlevoix Harbor, Mich., 2065; Frankfort Harbor, Mich., 2068; harbor of refuge at Portage Lake, Mich., 2069; Manistee Harbor, Mich., 2071; Ludington Harbor, Mich., 2072; Pentwater Harbor, Mich., 2075; White River Harbor, Mich., 2076; Muskegon Harbor, Mich., 2077; Grand Haven Harbor, Mich., 2079; Grand River, Mich., 2081; Black Lake Harbor, Mich., 2083; Saugatuck Harbor, Mich., 2084; South Haven Harbor, Mich., 2085; Saint Joseph Harbor, Mich., 2086; New Buffalo Harbor, Mich., 2087; Michigan City Harbor, Ind., 2088.

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APPENDIX L L.

REPORT OF LIEUT. COL. O. M. POE, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A.

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C. B. COMSTOCK, Lieut. Col. of Engineers, Bvt. Brig. Gen., U. S. A.,
CHARLES R. SUTER, Major of Engineers, U. S. A.,
Mr. HENRY MITCHELL, Coast and Geodetic Survey,
Mr. B. M. HARROD, Civil Engineer,
Mr. S. W. FERGUSON, Civil Engineer,
Mr. ROBERT S. TAYLOR,
Commissioners.

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REPORTS OF THE MISSOURI RIVER COMMISSION.

CHARLES R. SUTER, Major of Engineers, U. S. A., *President.*
ALEX. MACKENZIE, Major of Engineers,
O. H. ERNST, Major of Engineers,
Mr. G. C. BROADHEAD,
Mr. WILLIAM J. BROATCH,
Commissioners.

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UNITED STATES ARMY.

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REPORT OF MAJOR ALEXANDER MACKENZIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Upper Mississippi River, operations of snag-boat, &c.
2. Mississippi River from Saint Paul to the Des Moines Rapids.
3. Mississippi Rapids from Des Moines Rapids to mouth of Illinois River.
4. Harbors of refuge on Lake Pepin.
5. Removal of bar in Mississippi River opposite Dubuque, Iowa.
6. Ice-harbor at Dubuque, Iowa.
7. Rock Island Rapids, Mississippi River.
8. Harbor at Rock Island, Ill.
9. Des Moines Rapids, Mississippi River.
10. Operating and care of Des Moines Rapids Canal.
11. Dry-dock at the Des Moines Rapids Canal.
12. Quincy Bay, Illinois.
13. Removing obstructions in Mississippi River.

EXAMINATIONS AND SURVEYS.

4. Sny Island Levee, Illinois, on the Mississippi River.
15. Bar and obstructions at or near the mouth of Whipple Creek, in Quincy Bay, Illinois.
16. Mississippi River in the vicinity of Guttenberg, Iowa.

UNITED STATES ENGINEER OFFICE,
Rock Island, *Ill.*, *July* 8, 1885.

GENERAL: I have the honor to transmit herewith the annual reports of operations in my charge during the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Z 1.

OPERATIONS OF SNAG-BOATS IN IMPROVEMENT OF UPPER MISSISSIPPI RIVER.

The nature and amount of work carried on under this appropriation as well as statistics of commerce and navigation are given in the appended report of Assistant Engineer C. W. Durham.

There was available for work under this appropriation at beginning of fiscal year but $974.38, and the act of Congress approved July 5, 1884, omitted the usual item for this work. It has been necessary to make allotments from the general appropriations for carrying out such work as was indispensably necessary in the interest of navigation.

As an indication of the importance of the work carried on under this appropriation I give the following extract from the report made to the governor of Minnesota in December, 1884, by the "State commissioners for the improvement of the Mississippi River:"

> In all river and harbor bills up to, but exclusive of, bill approved July 5, 1884, an item of appropriation with above title has appeared. In the act approved July 5, 1884, the item was omitted. Why this was done we cannot say, unless it was assumed that the work was covered by the item "Removing snags from Mississippi River," but the work on the Upper Mississippi is not covered by the appropriation for the Mississippi River.
>
> The work carried on under the title "Improving Upper Mississippi River, operating snag-boats," &c., is most important. An estimate with this title has been submitted to Congress, and in any bill framed the item should not be omitted. Unless an appropriation is made, the snag-boats must lie idle, and between Saint Paul and the mouth of the Missouri boats must suffer the consequences. The Upper Mississippi is full of wrecks, many of which are liable in themselves to become obstructions; these and snags and falling trees are liable at any time to seriously obstruct or even prohibit navigation. The means must, in the interest of upper river navigation, be at hand for their removal.
>
> The records will show that since the Government commenced its work of operating snag-boats, &c., on the Upper Mississippi, the wrecking of boats has ceased, and the money return to navigators and the general public, as a result of the work of snagging, &c., is inestimable.

In my last annual report I referred to the subject of removal of wrecks and temporary work of cutting channels, and recommended the construction of a dredge to be operated in connection with the snag-boats. As it was practicable during the past season to construct a dredge under the general appropriation "improving Mississippi River, Saint Paul to Des Moines Rapids," and as this dredge will be at times available for use in connection with snagging outfit, the recommendation of last year is not here repeated.

The work carried on under this appropriation is of very great importance to the interests of navigation, and, if it is the desire of the Government to foster the carrying trade of the Upper Mississippi at the present time of low freights and railroad competition, may almost be called indispensable. If such trade is to be successfully continued, the expenses incident to delays, damages, &c., resulting from snags, wrecks, overhanging trees, &c., must be reduced to the lowest possible limits.

That the preservation of successful navigation on the Upper Mississippi is a necessity must be admitted, and so long as this work must be provided for by an item in the river and harbor bill, it is liable to be interrupted by the failure of the bill. I believe that permanent provision should be made for this work of snagging, wrecking, tree cutting and pulling, clearing banks, finding and marking new channels, making surveys, soundings, and examinations, assisting boats in distress, watching and repairing existing improvements, investigating and supervising work on bridges, collecting physical data and statistics of commerce and navigation, and in general facilitating and reducing expenses of navigation. To carry on this work properly would cost approximately $30,000 a year.

The operations of snag-boats on the Upper Mississippi should be placed on the same footing as the canals now operated by the Government, in accordance with provisions of the act of March 3, 1881.

An appropriation of $30,000 is recommended for the next fiscal year. This estimate is based on necessary operating expenses, and cannot be reduced without affecting efficiency of the work.

ABSTRACT OF APPROPRIATIONS.

By act approved March 2, 1867	$96,000
By allotment from appropriation of July 25, 1868	26,000
By allotment from appropriation of 1869	35,640
By act approved July 11, 1870	36,000
By act approved March 3, 1871	42,000
By act approved June 10, 1872	42,000
By act approved March 3, 1873	25,000
By act approved June 23, 1874	25,000
By act approved March 3, 1875	25,000
By act approved August 14, 1876	30,000
By act approved June 18, 1878	41,500
By act approved March 3, 1879	20,000
By act approved June 14, 1880	8,000
By act approved March 3, 1881	25,000
By act passed August 2, 1882	25,000
	502,140

Money statement.

July 1, 1884, amount available	$974 38
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	974 38
Amount that can be profitably expended in fiscal year ending June 30, 1887	30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. C. W. DURHAM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., July 1, 1885.

MAJOR: I have the honor to present my annual report on improving Upper Mississippi River for the fiscal year ending June 30, 1885, together with some statistics of commerce and navigation.

OPERATIONS OF SNAG-BOAT GENERAL BARNARD.

During the early part of July, 1884, the Barnard was put in repair and repainted. On July 22 she was brought out of the Des Moines Rapids Canal and put in commission for snagging. On the same day she left Keokuk for below, arriving at Saint Louis on the 23d. Left Saint Louis July 26, on her way up-river. On August 2, near Sabula, pulled the Bronson off a sand bar; reached Saint Paul August 8; operated between Saint Paul and Hastings until August 13, and then returned down-river. On September 2 she closed her snagging cruise at Keokuk.

During the remainder of the season up to November 19, when she was laid up for the winter in the canal, the Barnard was employed in assisting the towing of fleets to Guttenberg, Iowa, thence to Fort Madison, Iowa, and back to the canal at Keokuk. While work was going on at these points she served as a quarter-boat for a portion of the force employed in constructing dams and shore protections. She was in snagging service forty-two days in 1884, and removed obstructions from the channel at or near the following-named points: Grafton, Reed's Landing, Louisiana, Hickory Chute, Armstrong's, Marion City, South River, Fabius Island, Canton, Devil's Island, Burlington, Henderson River, Keithsburg, Muscatine, Gordon's Landing, Jack Oak

Slough, Lynxville, Bad Axe Bend, Coon Slough, Red Wing and La Crescent; also between Saint Paul and Hastings.

During the winter of 1884–'85 the Barnard lay in the canal, and on June 15, 1885, after some slight repairs, was sent to Fountain City with a tow of barges. She arrived at that point June 29 and was laid up.

OPERATIONS OF SNAG-BOAT J. G. PARKE.

The Parke lay in the canal undergoing repairs and repainting until September 4, 1884. On that day she started with a tow of barges for Cassville Slough and was employed at that locality and at Fort Madison in building dams and shore protections until the close of the season. Incidental to her work of towing barges she ran 3,369 miles.

During the winter of 1884–'85, and up to the present time, she has lain in the canal.

SUMMARY OF OPERATIONS OF SNAG-BOAT GENERAL BARNARD FOR FISCAL YEAR ENDING JUNE 30, 1885.

Snags removed	243
Leaning trees pulled back	27
Leaning trees felled and removed	944
Steamboats assisted	1
Water gauges established	3
Miles run	2,183

There follows a statement of snag-boat service for the past seventeen seasons:

Improving Upper Mississippi River.—Summary of operations of snag-boats, 1868 *to* 1884, *inclusive.*

Season.	Snag-boats.	Snags extracted.	Leaning trees felled and removed.	Leaning trees pulled back.	Steamboats, barges, and rafts pulled off bars.	Miles run.	Remarks.
1868	Montana and Caffrey.	329	344	......	......	5,904	
1869	......do	475	505	......	......	......	Water very high and boats employed but little; a small amount of dredging was done.
1870	......do	......	......	......	......	......	No detailed report.
1871	......do	498	656	......	33	7,292	Season of four months; built 1,600 feet wing-dams.
1872	......do	1,292	2,550	......	10	6,730	Last season of the Caffrey.
1873	Montana	5	16	......	11	2,263	Piles driven and jetties constructed at Pig's Eye, Newport, Rollingstone, and Betsy Slough.
1874	......do	15	45	......	2	3,862	Three wrecks removed; Pig's Eye Dam built.
1875	......do	47	169	......	18	3,535	Built Dam No. 1, Nininger Slough.
1876	......do	37	3,136	......	2	1,184	Built Dam No. 2, Nininger Slough; removed sunken barge at La Crosse; made several surveys.
1877	......do	94	6,358	68	18	4,482	Island numbers, 150; channel marks, 19; surveys at 15 localities.
1878	......do	152	3,944	36	7	4,997	Made 14 miles of survey; wrecks removed, 1; established 28 water-gauges and 29 bench-marks.
1879	General Barnard	547	4,421	122	18	7,167	Wrecks removed, 3; established 3 buoys and 6 channel marks.
1880	......do	265	4,351	47	4	3,994	High-water elevations taken, 46.
1881	......do	520	14,705	73	8	6,554	Wrecks removed, 2. In Cuivre River, 94 snags; 30 leaners pulled back, and 13,485 trees felled.
1882	......do	143	728	67	......	2,024	Wrecks removed, 3.
1883	General Barnard and Parke.	119	167	24	2	2,862	Trip to New Orleans and the jetties with Senate committee.
1884	General Barnard	243	944	27	1	2,183	Only forty-two days in commission.

RIVER NOTES.

The river remained at a good boating stage until the latter part of July. During the remainder of that month and the month of August the water was quite low, especially between Saint Paul and Hastings, but steamboats had no difficulty in reaching Saint Paul, the worst bars having been improved or eradicated. The General Barnard, a large side-wheel boat, went through to Saint Paul August 8, 1884, on a stage of less than 2 feet.

STATISTICS OF COMMERCE AND NAVIGATION.

Lumber.—The most important business interest on the Upper Mississippi River and its principal tributaries is the lumber trade, which gives employment to great numbers of men, and upwards of one hundred steamboats, which are used in guiding and propelling rafts. Between the mouth of the Chippewa and Saint Louis there are eighty mills on the main river, with an annual day-sawing capacity of 800,000,000 feet, employing some sixteen thousand men and representing about $20,000,000 capital.

On the Upper Mississippi and its tributaries, the Saint Croix, Chippewa, Wisconsin, and Black, there are about two hundred mills engaged in the manufacture of lumber, the greater part of which product is floated into the former stream.

Steamboats and freights.—The principal steamboat lines on the Upper Mississippi River are the Saint Louis and Saint Paul Packet Company and the Diamond Jo Line. There are also independent boats carrying freight and passengers.

During 1884 the Diamond Jo Line carried 173,517 tons of freight and 32,905 passengers. Statistics of the other line could not be obtained.

Statement of amount of freight received at and shipped from Saint Louis by the Upper Mississippi River for five years.

Saint Louis.	1884.	1883.	1882.	1881.	1880.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Received	129, 895	126, 330	135, 540	190, 815	226, 095
Shipped	43, 110	60, 020	71, 325	54, 295	55, 260
Total	173, 005	186, 350	206, 865	245, 110	281, 355

Movement in flour and grain by Upper Mississippi boats in 1884.

Saint Louis.	Flour.	Wheat.	Corn.	Oats.	Rye.	Barley.
	Barrels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Receipts	48, 080	459, 420	95, 700	631, 071	8, 323	205, 278
Shipments	4, 558	22, 210	22, 413	2, 935	1, 120	56
Total	52, 638	481, 630	118, 113	634, 006	9, 443	205, 334

The following table affords a comparative view of the relative amount of navigation at various localities on the Upper Mississippi River for the last three years:

Statement of steamers, barges, and rafts passing various bridges.

Locality of bridge.	Steamboats.			Barges.			Rafts.		
	1884.	1883.	1882.	1884.	1883.	1882.	1884.	1883.	1882.
Hastings	845	746	2, 563	980	751	710	8	(*)	60
Winona	2, 992	4, 893	5, 627	905	828	942	2, 007	1, 352	1, 939
La Crosse	5, 160	4, 316	4, 728	542	506	576	1, 920	1, 663	1, 707
Dubuque	3, 451	3, 585	4, 345	1, 119	867	822	1, 401	1, 422	1, 022
Sabula	2, 510	2, 454	2, 584	1, 248	594	317	1, 097	2, 083	(*)
Clinton	2, 926	3, 006	3, 185	628	592	670	†474	†499	†437
Rock Island	2, 708	2, 561	2, 593	203	142	293	1, 083	972	984
Burlington	1, 966	1, 943	2, 323	258	291	466	440	379	425
Keokuk	3, 014	1, 856	2, 034	1, 624	400	814	†296	†287	444
Quincy	1, 658	1, 648	2, 087	430	440	654	418	380	391
Hannibal	2, 863	2, 886	3, 031	504	472	578	†105	262	300
Louisiana	1, 212	1, 513	1, 249	308	393	472	126	113	111

* No record of rafts. † Partial record.

RIVER ACCIDENTS IN 1884.

April 27, steamer Grand Pacific struck a pier of the Burlington Bridge and sunk. Total loss. Wreck afterwards removed by snag-boat General Barnard.

April 29, steamer Sidney struck the bridge at Clinton, Iowa, and sunk. Raised and repaired.

September 2, tow-boat A. M. Jarrett caught fire and burned to water's edge at Quincy.

CUSTOMS REVENUE AND TONNAGE FOR YEAR ENDING DECEMBER 31, 1884.

That portion of the Mississippi River between Saint Paul and the mouth of the Illinois lies partly in the customs district of Minnesota and partly in the district of New Orleans. Surveyors of customs are located at Burlington and Dubuque, Iowa, Galena, Ill., Saint Paul, Minn., and La Crosse, Wis.

In the following statement is given the total exhibit of the port of Saint Louis, where the greater part of the Upper Mississippi boats are registered, and which includes many of the Lower Mississippi, Missouri, and Illinois river boats.

Ports.	Collections.	Enrolled tonnage.	Vessels.
Saint Louis	$1,447,328 44	168,523 71	270
Burlington	....	4,898 30	46
Dubuque	2,578 10	3,998 00	22
La Crosse	2,021 95	3,543 28	40
Galena	1,646 13	2,425 15	24
Saint Paul	63,849 45	2,794 00	30

INTERNAL REVENUE.

There are eight internal-revenue districts bordering on the Mississippi River between Saint Paul and the mouth of the Illinois River. Each of these districts is composed of a large number of counties, the greater portion of which do not touch the river, but the bulk of the revenue to the Government comes from the sections adjacent to the river and tributary to its navigation and commerce.

I give below a table showing the designation of the districts touching on the river between the points above named, the residence of the collector, and the amount of collections for the year ending December 31, 1884:

Districts.	Residence.	Amount.
First Minnesota	Saint Paul	$491,462 79
Second Wisconsin	Madison	153,529 36
Sixth Wisconsin	Sparta	182,248 18
Second Iowa	Davenport	2,351,360 08
Third Iowa	Dubuque	203,801 25
Fourth Iowa	Burlington	86,259 09
Fourth Illinois	Quincy	309,991 40
Fourth Missouri	Louisiana	273,831 63
Aggregate		4,052,483 77

Very respectfully, your obedient servant,

C. W. DURHAM,
Assistant Engineer.

Maj. A. MACKENZIE,
Corps of Engineers, U. S. A.

Z 2.

IMPROVEMENT OF THE MISSISSIPPI RIVER FROM SAINT PAUL TO DES MOINES RAPIDS.

Under this general appropriation are carried on works for the improvement of through navigation, the nature of which has been fully given in previous reports.

The allotment of this appropriation to various works and localities has usually been left to the discretion of the Secretary of War. This principle has resulted to the great advantage of the general improvement of the river, inasmuch as it permitted the expenditure of the appropriation on work at points where it was most needed, which points, as a rule, are away from cities and, while well known to those actually engaged in navigating the river or carrying on works of improvement, do not receive so great consideration from others as do points near towns or cities which are constantly under the eyes of the inhabitants. The river and harbor act of July 5, 1884, made special reference to several points, while there existed other points where the sums set aside could have been used to better advantage. The limited appropriation made for this work renders it very desirable that the selection of places for improvement should be left to the Secretary of War, in order that the money may be properly apportioned and the work performed where most needed.

There was available at the beginning of the fiscal year 22,950.03, to which 250,000 was added by act of July 5, 1884. The expenditures of the year exclusive of outstanding liabilities were $192,872.24. All the funds available could have been spent; but the failure of Congress to grant any further appropriations made a more gradual expenditure advisable.

During the past year, as formerly, work has been carried on by contract when circumstances permitted, and by means of the Government plant and hired labor when such method was "most economical and advantageous to the Government." Works of improvement were carried on during the year by day's labor between Saint Paul and Hastings; between Reed's Landing and Winona; in vicinity of La Crosse, Fountain City, Cassville Slough, Guttenberg, and Fort Madison. Work was done by contract and agreement at West Saint Paul, Bad Axe Bend, Rock Island Rapids, Andalusia, and Muscatine. Material was purchased under contract and in open market, the latter being found to secure the lowest prices and give most satisfactory results.

The buoying of Rock Island Rapids was provided for by this appropriation, and a small allotment was made for the snag-boat General Barnard.

Some important additions to the Government plant were built and a number of surveys and examinations made in connection with works of improvement and bridges across Upper Mississippi River.

The details of work at the several localities are given in the appended reports of Assistant Engineers C. W. Durham and J. L. Gillespie, under whose direction the improvements above enumerated were carried out.

The river and harbor act of July 5, 1884, provided, under the general appropriation, for "improving Mississippi River from Saint Paul to Des Moines Rapids," for work at Andalusia, Muscatine, and Fort Madison, and "for the protection of the bank of the Mississippi River at Winona, Minnesota," &c.

The work proposed at Andalusia was in continuation of a project presented in a report submitted December 17, 1880, and partially carried out under special appropriation in 1881. Work was done under contract with Mr. A. J. Whitney, of Keokuk, Iowa, between September 15 and November 16, 1884. It consisted in the repair and extension of existing work, and the construction of a closing dam across Andalusia Chute. Gravel, rock, and brush were used. Good results are already apparent.

An allotment of $4,500 was made for dredging in the harbor of Muscatine, Iowa, in continuation of work formerly carried out under special appropriations. Under agreement with A. J. Whitney, at the rate of 10 cents per cubic yard, dredging was commenced October 13, 1884, and completed November 22. The amount of material excavated and removed was 44,418 cubic yards. Further trouble is not expected in this harbor for several years to come. Details of work at Fort Madison are given in appended report of C. W. Durham, assistant engineer.

No work was carried on at Winona, there being no caving banks to protect, as indicated in the item in the river and harbor act. The bank at Winona is a gently-sloping gravel beach, and the main trouble at the landings is the shoalness of water and too slack current. It would be well if the city of Winona should pave its levee, as other cities have done; but there is at present no work of protection which the Government can properly do which is necessary or which would not materially injure the city wharf for landing purposes.

After verbal communication with the mayor and citizens of Winona, to whom the actual condition of affairs and results of surveys were explained, I received from the board of trade a copy of a resolution indorsing my ideas and suggestions, and asking that the work carried out be such as would result in removing the sand-bars lying along the bank in front of the lower part of the city. The work referred to in the item of appropriation being impracticable, unnecessary, and evidently the result of a misunderstanding, has not been attempted during past year.

The river and harbor act of August 2, 1882, provided that of the $200,000 appropriated for "improving Upper Mississippi River from Saint Paul to Des Moines Rapids" the sum of $15,000 should be expended for improving banks and the channel of the river at West Saint Paul. It being impracticable for a time to determine the nature of the work desired or expected, a delay in the expenditure of this allotment was necessary.

A project was finally submitted under date of October 28, 1884, for dredging a basin along the right bank of the river which would serve as a harbor or channel for boats desiring to land at West Saint Paul. The project also included the construction of such dams and shore protections as were necessary for preserving the channel of the river along the left bank. Dredging work was begun May 6, 1885, under contract with Mr. C. H. Appleton, of Quincy, Ill., the price being, for excavating and removing material to a distance on an average less than 3 miles, 16⅔ cents cubic yard. Up to July 27, 28,309 cubic yards have been removed. The contractor has been permitted to make arrangements for delivering a portion of the dredged material to the city of Saint Paul for filling purposes.

The difficulties and dangers of navigation resulting from insufficient protection at the various bridges over the Upper Mississippi have been referred to in previous reports. Section 8 of the river and harbor act of July 5, 1884, provided for the carrying out under certain conditions of such work looking to improvement of navigation through bridges over navigable waters of the United States as the Secretary of War might think necessary. There are fourteen bridges in the section of the Upper Mississippi in my charge, and considerable labor and expense have been involved in the making of surveys and collection of opinions and facts, preparation of plans for improvement, and correspondence and interviews with representatives of the various bridge companies. The Secretary of War, having decided that the indefinite appropriation which provided for carrying out the work of construction cannot be used for expenses of preliminary examinations and preparation of plans, and there being no funds available from appropriation for "improving Upper Mississippi River," which usually covers such work, it was necessary to make an allotment from this general appropriation. Plans have been prepared for bridges at Hastings, Winona, La Crosse, Dubuque, Clinton, Burlington, Quincy, Hannibal, and Louisiana. It is to be hoped that the action of the bridge companies will be prompt. The act provides that the work shall be done by the United States in case of unnecessary delay on the part of the bridge companies; but considerable time must elapse before the Government would be justified in assuming it, and these important improvements would be thereby delayed.

The act of Congress of March 3, 1879, allotted $20,000 for the trial of the "Adams Flume," under the supervision of the inventor, and the act of August 2, 1882, contained an additional appropriation of $8,000 for this work. A bar below Reed's Landing was, in accordance with Mr. Adams's wishes, assigned to him for his experiment; but in 1882 the condition of bars, &c., became such as to make a change of experimenting ground desirable. With Mr. Adams's sanction and approval, Frenchman's Bar, below Saint Paul, was assigned him for his operations. Since 1879 Mr. Adams has been preparing for his experiments; but as yet no pipes have been laid in the river, and no report as to results accomplished can yet be submitted. The conditions at Frenchman's Bar are changing, and it may be necessary for Mr. Adams to select still another locality for a practical test of the machinery he has been constructing during the past six years.

The construction of a dredge and six dump-boats for use in connection with improvements carried on under this head of appropriation, which has been recommended in previous reports, was commenced during past year and will be completed in a short time. Two launches for towing purposes were built and six flat-boats nearly completed. A new hull was constructed for Tow-boat No. 1.

The works heretofore carried out have continued to exercise a favorable effect on the low-water channel of the river, and the results have been of great benefit to the interests of navigation, and, through these interests, to the public at large. The fact has been demonstrated that so long as the river can be navigated with certainty and comparative ease freight rates will be kept down to a very low figure, and it is believed that no legislation looking to the regulating of freight rates is of more importance or will furnish more beneficial results than such as will permit the rapid continuance and completion of the improvements of the Upper Mississippi.

Extracts showing the results of work have been given in previous reports, to which I would add the following:

From Governor Hubbard's message to the Minnesota legislature, January 8, 1885:

> I transmit herewith a report of the "State commissioners for the improvement of the Mississippi River," in which the interests of our State, in connection with the expenditures by the General Government for the improvement of Western rivers and harbors, are practically considered. It is of great interest to Minnesota and the

Northwest that the system under which work has been prosecuted since 1878 for the improvement of navigation on the Upper Mississippi, from Saint Paul to the Des Moines Rapids, should be developed as rapidly as possible until its full benefits are realized. Results already accomplished assume the certainty of a channel of sufficient depth to accommodate the largest upper river-steamers during all seasons of an open river. * * *

From the report of the State commissioners of Minnesota:

* * * * * * *

There has been expended in connection with the permanent improvement of the Upper Mississippi up to the present time, under the head of "Improving the Mississippi River from Saint Paul to Des Moines Rapids," a distance of 515 miles, about $1,000,000. * * *

The results accomplished with this comparatively small expenditure have been most beneficial to the interests of navigation. The most troublesome obstructing sand-bars have been removed, and in the upper portion of the river the ruling depths have been increased about 2 feet.

* * * * * * *

But while so much can be said regarding work already carried out, it remains a fact that the improvement is in its infancy. What has been accomplished on the Upper Mississippi simply demonstrates that the experimental stage is passed; that the plans being followed are correct, and that, when carried to completion, they will accomplish all that is claimed for them, and that such completion will give to the Northwest an uninterrupted channel to the sea, free to all, and of sufficient capacity to satisfy the needs of commerce for all time, and with such a line of communication open freight rates must and will be reduced to their lowest possible limit.

With a full knowledge of the great good to result from the completion of the improvements of the Upper Mississippi, and a further knowledge from practical experience that this improvement is certain to follow a continuation of the work now going on, it is most desirable that the work not only be continued, but that appropriations be granted sufficiently great to permit of its completion within a reasonable time, to the end that present as well as future generations may feel the full benefit therefrom. * * *

From a memorial presented to Congress by the Minnesota legislature—

* * * * * * *

These results already attained justify the belief that, under the well-digested plans, the engineers in charge can, with the money now asked for by them, secure such a depth of water as will allow wheat to be transported from the Falls of Saint Anthony to the Belize and put on board of ships to be conveyed to Europe, and flour to our South American and Mexican neighbors, at freight charges not to exceed one-third those now paid to reach the markets. Wheat at 8 cents per bushel (freight) on board ship at the Belize means $6,400,000 per year saved to Minnesota on her present production.

The improvement of the Upper Mississippi River from Saint Paul to Des Moines Rapids can be carried on to far greater advantage with large than with such small appropriations as have heretofore been made.

I would respectfully recommend an appropriation of $1,500,000 for the fiscal year ending June 30, 1887, and if further provision for several years could be made at the same time great good would result therefrom.

The section of the river for which this appropriation is recommended is about 525 miles in length, and the amount suggested will give less than $3,000 per mile.

Commercial statistics relating to the Upper Mississippi River will be found in connection with my report on "Improving Upper Mississippi River."

SUMMARY OF EXPENDITURES FOR FISCAL YEAR ENDING JUNE 30, 1885.

Saint Paul to Hastings	$46,071 05
Dredging at West Saint Paul	4,789 38
Reed's Landing to Winona	25,812 03

Dredging at Bad Axe Island	$6,754 43
Vicinity of La Crosse	136 55
Vicinity of Fountain City	1,996 15
Cassville Slough and Guttenberg	13,963 90
Dredging Campbell's Chain	1,920 68
Vicinity of Andalusia	17,507 61
Buoys on Rock Island Rapids	1,498 24
Dredging Muscatine Harbor	5,005 54
Vicinity of Fort Madison	13,966 58
Rock at Nauvoo (not used)	608 10
Purchase and repairs of plant	47,873 14
Snag-boat General Barnard	926 46
Surveys and gauges	4,042 40
Total	192,872 24

NOTE.—Of above amount, $652.51 was reported as outstanding liability July 1, 1884.

Expenditures on the various sections of the river between Saint Paul and Des Moines Rapids from commencement of improvement to July 1, 1885.

Locality.	Distance, miles.	Amount.
Saint Paul to Hastings	27	$236,460 79
Hastings to head of Lake Pepin	32	46,291 52
Head of Lake Pepin to Alma	36	183,121 07
Alma to Winona Bridge	29	175,580 55
Winona Bridge to La Crosse Bridge	31	41,018 05
La Crosse Bridge to McGregor Bridge	72	31,447 75
McGregor Bridge to Dubuque Bridge	59	49,968 31
Dubuque Bridge to Clinton Bridge	67	17,057 48
Clinton Bridge to Rock Island Bridge	40	3,725 76
Rock Island Bridge to Keithsburg	58	31,179 13
Keithsburg to Des Moines Rapids	60	130,156 28
Surveys and meter work	....	57,070 60
Snag boats and wrecking	....	7,446 26
Plant at estimated value	....	89,154 25
Total	....	1,099,677 80

The existing project for this work is one of general plans and methods rather than details.

No definite estimate of the cost of completion has ever been presented, and no such figures can well be given. Nor are they necessary. In preparing projects for special localities where definite plans and locations of works could not be fixed upon long in advance of construction, the estimated cost has been taken at $20,000 per mile. Projects for the expenditure of each appropriation, in accordance with approved plans, are presented in lieu of a general project for completion of work.

No figures are given for amount required for completion of existing project.

ABSTRACT OF APPROPRIATIONS.

By act approved June 18, 1878	$250,000
By act approved March 3, 1879*	100,000
By act approved June 14, 1880	150,000
By act approved March 3, 1881	200,000
By act passed August 2, 1882	250,000
By act approved July 5, 1884	250,000
Total	1,200,000

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* Twenty thousand dollars set aside for testing Adams's flume.

Money statement.

July 1, 1884, amount available		$22,950 03
Received from sale of fuel		118 75
Amount appropriated by act approved July 5, 1884		250,000 00
		273,068 78
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$192,220 03	
July 1, 1885, outstanding liabilities	4,856 30	
		197,076 33
July 1, 1885, amount available		75,992 45
Amount that can be profitably expended in fiscal year ending June 30, 1887		1,500,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of all proposals received and opened this 5th day of September, 1884, at 2 p. m., by Maj. A. Mackenzie, Corps of Engineers, for furnishing riprap on board Government barges in the Mississippi River between Saint Paul and Hastings, Minn.

No.	Names and residences of bidders.	10,000 cubic yards delivered on United States barges.	
		Cubic yards.	Amount.
1	S. J. Truax, Hastings, Minn	$0 74½	$7,450
2	S. W. Chase F. M. Underwood } Minneapolis, Minn	74	7,400
3	A. H. Truax, Hastings, Minn	69	6,900

Abstract of proposals received and opened this 5th day of September, 1884, at 2 p. m., by Maj. A. Mackenzie, Corps of Engineers, Rock Island, Ill., for furnishing riprap on board Government barges in the Mississippi River between Reed's Landing and Winona, Minn.

No.	Names of bidders.	Residence.	Approximate quantity delivered on barges 10,000 cubic yards.	
			Per cubic yard.	Amount.
1	W. Patt A. Fuoter	Alma, Wis	$0 71½	$7,150
2	Winona Stone and Lime Company	Winona, Minn	65	6,500
3	S. J. Truax	Hastings, Minn	84½	8,450
4	John Harry	Alma, Wis	71½	7,150
5	Chase & Underwood	Minneapolis, Minn	95	9,500

Abstract of proposals received and opened this 5th day of September, 1884, at 2 p. m., by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., for constructing a dam and shore protection of brush and stone at Andalusia, Ill.

No.	Names of bidders.	Residence.	5,000 cubic yards stone.		4,000 cubic yards brush.		Aggregate.
			Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	
1	Patterson Brothers	Keokuk, Iowa	$1 40	$7,000	$0 65	$2,600	$9,600
2	Daniel Keleher	Davenport, Iowa	1 75	8,750	1 40	5,600	14,350
3	J. W. Heisey	Burlington, Iowa	1 70	8,500	1 00	4,000	12,500
4	Fruin, Bambrick & Co	Saint Louis, Mo	1 90	9,500	1 10	4,400	13,900
5	C S. Whitney	Keokuk, Iowa	1 35	6,750	85	3,400	10,150
6	A. J. Whitney	...do	1 25	6,250	70	2,800	9,050

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., at 2 p. m. on February 16, 1885, for construction of dredge hull.

No.	Names of bidders.	Residence.	Point of delivery	Price.
1	Alex. D. Fleak*	Grafton, Ill	Grafton, Ill	$4, 548
2	Edmonds J. Howard	Jeffersonville, Ind	Jeffersonville, Ind	4, 800
3	Alfred Cutting †	Metropolis, Ill	Metropolis, Ill Keokuk, Iowa	3, 050 3, 250
4	J. Batchelder	Baytown, Minn	do	3, 795
5	Diamond Jo line of steamers*	Dubuque, Iowa	do	3, 500
6	H. S. Brown	Quincy, Ill	Quincy, Ill	4, 500
7	Van Sant & Edwards	Le Claire, Iowa	Le Claire, Iowa Keokuk, Iowa	4, 740 4, 815
8	Kahlke Brothers	Rock Island, Ill	do	4, 490
9	Jacob Eckhardt & Son	Davenport, Iowa	Davenport, Iowa	5, 950

*Not signed. † Accepted, question of towage to Keokuk to be determined hereafter.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, at 2 p. m., for furnishing 6,000 cubic yards riprap rock and delivering the same on United States barges between Saint Paul and Hastings, Minn.

No.	Names of bidders.	Residence.	Point of delivery.	Price per cubic yard.
1	Nels. J. Ness	Saint Paul, Minn	No point mentioned	$1 75
2	S. McDonald	Casselton, Dak	do	1 75
3	A. H. Truax	Hastings Minn	Nininger, Minn	53
4	Patrick H. Thorton	Saint Paul, Minn	Saint Paul, Minn	1 30
5	Caleb Truax	Hastings, Minn	Merrimac or Newport, Minn	61½
6	Winston Brothers	Minneapolis, Minn	Red Rock and Newport, Minn	87

All rejected.

Stone required for use at Saint Paul as per specification. Item 3 requires an up-stream tow of 23 miles; item 5 an up-stream tow of about 9 miles, making the bid of Caleb Truax the most advantageous (tow to be considered as per specifications). But 61½ cents per yard equals $2.92¼ per cord, while the price now paid in open market at Newport and Merrimac is but $2.70 per cord. It is therefore more advantageous to the Government to reject all proposals and purchase in open market.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, at 2 p. m., for furnishing brush and poles, and delivering the same on United States barges between Saint Paul and Hastings, Minn.

No.	Names and residences of bidders.	Brush, 6,000 cubic yards.	Poles, 6,000.	Amount.	Remarks.
		Per cu. yd.	*Per pole.*		
1	S. McDonald, Casselton, Dak.	$0. 75	$0 25	$6, 000	Between Saint Paul and Hastings.
2	A. H. Truax, Hastings, Minn	34	03½	2, 250	Delivered near Saint Paul.
3	George Robinson, Stillwater, Minn.	34½	03	2, 250	3,000 yards brush and 3,000 poles at Grey Cloud Landing. 3,000 yards brush and 3,000 poles at Minnesota River.
4	George H. Daly, Langdon, Minn.	35½	04	2, 370	Between Saint Paul and Hastings.

The bids of A. H. Truax and George Robinson being the same, a division of award is made, Mr. Truax furnishing 3,000 yards of brush and 3,000 poles near Saint Paul and Mr. Robinson 3,000 yards of brush and 3,000 poles at the mouth of the Minnesota River.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, at 2 p. m., for furnishing 10,000 cubic yards riprap rock, and delivering the same on United States barges between Reed's Landing and Winona, Minn.

No.	Name of bidder.	Residence.	Point of delivery.	Price per cubic yard.
*1	Samuel McDonald	Casselton, Dak	Between Reed's Landing and Winona.	$1 75

* Rejected; price exorbitant, being more than two and one-half times as much as is paid in open market.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, at 2 p. m., for furnishing 10,000 cubic yards riprap rock, and delivering the same on bank of river between Lansing and Dubuque, Iowa.

No	Names of bidders.	Residences.	Point of delivery.	Price per cubic yard.
1	S. McDonald	Casselton, Dak	Between Lansing and Dubuque.	$1 83
2	John H. Friend*	Elkador, Iowa	5,000 cubic yards at Clayton, Iowa.	1 00
3	M. McCarten	Dubuque, Iowa	Dubuque and Guttenberg, Iowa.	96
4	Thomas Finn	do	At or near Lynxville, Viola, Wyalusing, Glen Haven, Johnsonsport, and Speett's Ferry.	79
5	D. W. Lineham	do	Various points	90
6	Albert Warren†	Rock Island, Ill	Glen Haven Wyalusing Guttenberg Crooked Slough	60 57 70 65

* Informal; not in duplicate.

† In lots of 2,500 cubic yards at each point.

Bids all rejected; prices asked being higher than the material can be, and has been, purchased in open market.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, at 2 p. m., for furnishing 10,000 cubic yards riprap rock, and delivering the same on bank of river between Rock Island, Ill., and Montrose, Iowa.

No.	Names of bidders.	Residences.	Point of delivery.	Price per cubic yard.
1	S. McDonald	Casselton, Dak	Rock Island to Montrose	$2 25
2	Rudolph Wiegand*	Nauvoo, Ill	Nauvoo, Ill	59½
3	Wm. Amos Roberts*	do	do	50½
4	M. W. Dodge	Buffalo, Iowa	Via Buffalo, Iowa	60
5	J. A. Green*	Stone City, Iowa	Davenport, Iowa	3 25
6	Michael Hines	Davenport, Iowa	Montpelier and other points	79
7	John Loftus	Burlington, Iowa	Burlington, Iowa	63
8	Patterson Bros†	Keokuk, Iowa	Nauvoo, Ill	48½
9	E. G. Kempert‡	Burlington, Iowa	do Burlington, Iowa	50 78
10	Danl. Keleher§	Davenport, Iowa	Between Rock Island and Muscatine.	65

* Informal; no guarantee.

† Accepted; written contract made.

‡ Five miles below Burlington.

§ Informal; no guarantee; only one bid.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, *at 2 p. m., for dredging in Mississippi River at Saint Paul, Minn.*

No.	Names and residences of bidders.	Dredging and removing material and depositing same at a distance not to exceed 3 miles per cubic yard.
1	Samuel McDonald, Casselton, Dak	$0 50
2	Carkin, Stickney & Cram, East Saginaw, Mich	45
3	A. J. Whitney, Keokuk, Iowa	17
4	*Charles H. Appleton, Quincy, Ill	16⅝
5	H. S. Brown, Quincy, Ill	20

*Accepted; written contract made.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, *at 2 p. m., for the construction of six flat-boats for use between Saint Paul and Des Moines Rapids.*

No.	Names and residences of bidders.	Point of delivery.	Price for the six.	Remarks.
1	D. S. Barmore & Son, Jeffersonville, Ind	Saint Louis, Mo	$8, 940 00	
2	Samuel McDonald, Casselton, Dak	Red Wing, Minn	37, 200 00	$6,200 each
3	A. D. Fleak, Grafton, Ill	Grafton, Ill	17, 910 00	$2,985 each; informal; no guarantee.
4	A. Cutting, Metropolis, Ill	Metropolis, Ill	9, 600 00	$1,600 each.
5	Thomas G. Isherwood, Le Claire, Iowa	Le Claire, Iowa	7, 800 00	Accepted; written contract made.
6	William W. Bates, Chicago, Ill	Rock Island and Davenport.	17, 000 00	
7	Van Sant & Edwards, Le Claire, Iowa	Le Claire, Iowa	7, 900 00	
8	J. Batchelder, South Stillwater	South Stillwater, Minn.	8, 190 00	
9	Carken, Stickney & Cram, East Saginaw	Some point above Keokuk.	10, 000 00	Conditional on acceptance of bid for dump-boats.
10	Martin Von Hein, Le Claire	Le Claire, Iowa	8, 160 00	
11	J. R Morgan & Son, Clinton, Iowa	Saint Louis, Mo	11, 400 00	
12	Jacob Elkhardt & Son, Davenport	Davenport, Iowa	9, 270 00	$1,545 each.
13	H. S. Brown, Quincy, Ill	Quincy, Ill	8, 500 00	
14	Kahlke & Bro., Rock Island	Rock Island, Ill	9, 390 00	$1,565 each; informal; no certificate.

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., on March 19, 1885, *at 2 p. m., for construction of six dump-boats for use in improvement of Upper Mississippi River.*

No.	Names and residences of bidders.	Point of delivery.	Price for the six with chains.	Price for the six without chains.
1	S. McDonald, Casselton, Dak	Some point north of Keokuk	‡$7, 800 00	‡$7, 750 00
2	A. Cutting, Metropolis, Ill	Metropolis, Ill		‡2, 800 00
3	Van Sant & Edwards, Le Claire, Iowa	Le Claire, Iowa	9, 600 00	9, 000 00
4	William W. Bates, Chicago, Ill	Rock Island, Ill., or Davenport, Iowa.	21, 000 00	20, 400 00
5	Carkin, Stickney & Cram, East Saginaw, Mich.	Some point north of Keokuk	‡2, 150 00	‡1, 750 00
6	M. Von Hein, Le Claire, Iowa*	Le Claire, Iowa		8, 340 00
7	J. Eckhardt & Son, Davenport, Iowa	Davenport, Iowa	‡1, 795 00	
8	H. S. Brown, Quincy, Ill	Some point north of Keokuk	10, 050 00	
9	Kahlke & Bro., Rock Island, Ill. †	Rock Island, Ill	‡1, 675 00	

*Accepted; written contract made. † Informal; no certificate. ‡ Each.

REPORT OF MR. J. L. GILLESPIE, ASSISTANT ENGINEER.

SAINT PAUL, MINN., *July* 2, 1885.

SIR: I have the honor to submit my annual report on the work of improving Upper Mississippi River carried on in the division under my charge during the fiscal year ending June 30, 1885.

SAINT PAUL TO HASTINGS.

Work in this section of river was done by hired labor and the usual plant, consisting of Tow-boat No. 1, Steam-launch No. 1, Pile-driver No. 74, Quarter-boat No. 13, and such barges as were necessary.

There were three crossings which had given trouble for several seasons at extreme low water—the Red Rock Crossing, the crossing at head of Grey Cloud Island, or Robinson's Rocks, and the crossing near the foot of Grey Cloud Island, or at head of Boulanger Slough. The first to attract attention this year was the crossing at Red Rock, and the season's operations consequently commenced at that point.

The fleet which had been in winter quarters at Boulanger's Slough was thoroughly repaired during July and August, and on August 15 Tow-boat No. 1 proceeded to Saint Paul for supplies.

On August 20 the construction of a shore protection opposite Red Rock was commenced. The work in this vicinity consisted of 2,350 feet of shore protection on right bank and two spur-dams from left bank; the upper dam a solid brush and stone dam, 300 feet long, and the lower one a pile-dam 550 feet long. This is the first pile-dam built on this section of river. Where prompt results are desired, and at points where the tendency of the river is to maintain large sand-bars, it is believed that the pile dam can be advantageously substituted for the brush and stone dam on account of the saving in time and cost. At exposed points where the ice in the spring is likely to run with much force, the solid dams will be necessary.

The work at Red Rock was mostly completed September 17, and the plant was moved to head of Grey Cloud Island or Robinson's Rocks. The work in this vicinity consisted of 3,600 feet of shore protection, commencing opposite Island No. 10 and extending up the river, and four dams. On the left bank, just below Robinson's Rocks, a solid brush and stone dam 300 feet in length was built, and 900 feet below this, on left bank, a dam 750 feet long, 500 feet of which, from shore end, is solid brush and stone, while the remaining 250 feet is pile-work. On the right bank two pile-dams were built, one 1,250 feet below Dam 64, 550 feet long, and one 1,400 feet still lower down, 400 feet in length. The river at this point is wide, and sand-bars made two quite bad crossings. It is probable that these four dams will enable the channel to clear itself before another season of low water, and they also make ample provision for retaining such material as may be moved out of the main channel. As usual there is much sawdust and mill refuse mixed with the material that compose these bars, and hence their removal by the action of the current alone becomes much more uncertain.

Work in the vicinity of Robinson's Rocks was mostly completed on the 17th of October, and the plant moved to a point on the right bank of the river, below Island No. 14, and the work of improving the bad crossings between there and Island No. 15 commenced. Six dams were built for this work, two from the right bank just above the head of Boulanger Slough, and four from the left bank opposite and above the head of Boulanger Slough. The upper one on the right bank is a solid brush and stone dam, 200 feet long, and the lower one, same side, a pile-dam, 350 feet long. The upper dam on the left bank was also built of brush and stone, its length being 300 feet. The three dams located below the last named and on same side are all pile-dams, the first one 400 feet long, the next 450 feet, and the third 350 feet in length. Two more dams are proposed to complete the series on the left bank.

A shore protection was placed on the right bank, commencing at the upper dam, No. 85, and extending up-stream 1,400 feet. Also one on Island No. 16, commencing at the upper end of the shore protection built in 1882, and extending up the river 800 feet.

At the point just below the head of Boulanger Slough the river makes a very decided and sudden bend, and the bank near the head of Island No. 16 requires a heavy protection. The sand-bar above has been very troublesome at low water for the last year or two, the material of which it is composed being quite loose and constantly shifting. It is expected that the six dams built at this point during the past season will cause the current to clean out this loose material and effect a passable channel before another low-water season.

A full description of all dams and shore protections constructed in this section of river during the past season is given in a report by Mr. J. F. Marr.

REED'S LANDING TO WINONA.

The first trouble experienced on this section of river at a low stage of water in the season of 1884 was at the crossing just above Wabasha. The formerly wide channel had divided into two or three tortuous channels, the one having the best water being so narrow and crooked that it was very difficult to use it. This channel passed around under the long wing-dam from the right bank just above Wabasha, and was entirely out of place. Upon an examination made by Assistant Engineer G. A. Marr just before commencing construction work at this point it was decided to put in three wing-dams, one from the right bank about 1,000 feet below the long wing-dam referred to above and two from the opposite bank. The dams on the left bank were built, but high water prevented finishing them up in satisfactory shape, and they may require attention another season. They are solid brush and stone dams, the upper one 675 feet long and the lower 900 feet in length. The high water also prevented the construction of the proposed dam from the right bank.

A shore protection 1,900 feet in length, extending from the entrance to Perrine Slough down to the shore protection built in 1881, was constructed, although the shore was mostly under water at the time. This will also require trimming hereafter.

The high water rendering the getting out of material at this point very difficult, and the need for work in the vicinity of Fountain City being urgent, operations at Wabasha were suspended on October 10, and the plant was moved to Fountain City.

The experiment of trying to keep openings in the dams at the head of Rollingstone Slough to permit of running logs into that slough by Winona parties, and at the same time maintain a good channel in the main river, was found to be an impossibility, for the reason that the openings caused such a strong draught of water into the slough that at a low stage the swift current thus created drew from the main channel a greater part of the water. It was decided to close these openings and raise the dams to 4.5 feet above low water. This was the first work done at this point, followed by the construction of two closing dams, one from Island No. 58 to Island 59, 225 feet long, and one from Island No. 61 to left bank, 225 feet long. The narrow channels thus closed had commenced to cut out, and quite deep water already was flowing through them. In the one between Island No. 61 and the left bank the current had become so strong that tow-boats had to use great care in passing that point with rafts.

Some repairs were made on the closing dam between Islands 57 and 58, and the shore protection on head of Island 58 was repaired and extended, covering 700 feet.

Island No. 59 was protected next the main channel for 800 feet.

A shore protection 500 feet in length was built around the head of Island No. 61.

The right bank (Island No. 60) opposite Fountain City having worn away quite rapidly during the last year or two, it was protected for a distance of 800 feet.

A shore protection was constructed on the left bank opposite Island No. 59, beginning at the old protection and extending 900 feet down-stream.

It had been intended that some work should be done at Winona before the close of the season, but the delay with the work above, caused by high water, rendered it impracticable to carry out this part of the season's project. The main channel at Winona, after leaving the draw of the railroad bridge, tends to make a crossing to the left bank opposite, and as a consequence the channel along the front of the city is shoaling quite rapidly and threatens the great lumber interests centered at that point.

For details of the work in this section of river I respectfully refer to the report of Mr. J. D. Du Shâne.

BROKEN ARROW ISLAND SLOUGH.

Having been informed by the chief engineer of the Winona, Alma and Northern Railroad that the rock owned by the Government and stored at Warner's Landing, Wisconsin, was in the way of grading for the railroad, arrangements were made with P. S. Davidson for loading 150 cubic yards of the rock, towing it to Dam 1^{28}, between Minnesota shore and Island No. 110 (just below La Crosse), and placing it in a break in the dam. About 150 cubic yards more of the rock were removed to points out of line of the railroad grading.

This work was done during the first week in July.

DREDGING IN BAD AXE BEND.

A tow-head at the foot of Bad Axe Bend about 600 feet long and 150 feet wide was removed by dredging. This tow-head was so located with reference to the present main channel of the river that raft boats had much difficulty in clearing their rafts at this point, the increased depth of water between the tow-head and left bank causing such a strong draught of water through that channel that the rafts tended very strongly to follow it; but the channel was too narrow for the passage of an ordinary sized raft.

A dredging outfit was hired of C. H. Appleton to remove the tow-head at the rate of $12.50 per hour of actual work. The work was done between July 28 and September 16, and required 503½ hours of actual work. The approximate amount of material removed was 38,150 cubic yards. This gave a clear free channel at this point much appreciated by river men.

EXAMINATIONS AND SURVEYS.

Examinations were made in July and the first half of August at the foot of Grey Cloud Island and at Nininger, which were mapped in this office, and tracings, with plans of work, prepared for use of construction parties.

The regular organization of party for survey work was not effected till August 18, when the Steam-launch No. 2 arrived at Saint Paul and operations under Assistant Engineer G. A. Marr were commenced at that point, the examination being made with reference to the improvements necessary for a harbor or landing in West Saint Paul. During the remainder of the season surveys were made at Red Rock Crossing, head of Grey Cloud Island, Wabasha, Fountain City, Winona, and Read's Landing. These surveys were all hastily mapped in the field and tracings furnished the construction parties.

From October 20 to November 10 Mr. Marr was employed in another division of river; and, on completion of the duties to which he was there assigned, returned to this office and commenced detail maps of his season's work.

For a full account of the examinations and surveys made in this division during the past season I respectfully refer to the report of Assistant Engineer Marr.

OPERATIONS IN 1885.

Surveys.—During the winter and spring surveys and examinations were made at Nininger Slough, at Red Rock, at the ponton bridge at Reed's Landing and at Winona. Maps showing the results of these surveys, and also of the survey made last fall at Guttenberg, Iowa, have been forwarded to Rock Island, with detailed reports on each.

Construction.—During the winter a new hull was built for the Tow-boat No. 1 (Alert), at South Stillwater, under contract with Mr. J. Batchelder, the machinery, cabin, and outfit being transferred from the old boat (Ada B).

The boat was launched May 8, and has since been employed on the work between Saint Paul and Hastings.

Two pile-dams were constructed above Island No. 16, and the opposite shore protected. On completion of this work the boat and barges were moved to West Saint Paul, and employed in the construction of two dams from Boat Club and Raspberry islands to the right bank, building shore protections on the channel side of these islands and building a wing and longitudinal dam below Boat Club Island. The area inclosed by the last-named dam is being dredged, under contract with C. H. Appleton, to afford a harbor and landing for West Saint Paul.

Details of the above work are given in the reports of Mr. J. D. Du Shane, overseer, and Mr. J. F. Marr, inspector, submitted herewith.

Very respectfully, your obedient servant,

J. L. GILLESPIE,
Assistant Engineer.

Maj. A. MACKENZIE,
Corps of Engineers, U. S. A.

REPORT OF MR. J. D. DU SHANE, OVERSEER.

SAINT PAUL, MINN., *July* 2, 1885.

DEAR SIR: I have the honor to submit the following data for the semi-annual report ending June 30, 1885:

On May 6 Tow-boat No. 1 (Alert) was launched at Baytown, Minn., by the contractor for the new hull, Mr. J. Batchelder, the machinery, outfit, and cabin having been transferred to the new hull and fitted up by day labor. On May 8 steam was raised and a trial made, the boat running to Stillwater and to Saint Paul on the 9th.

Tow-boat No. 1 then proceeded to Fountain City, Wis., and towed part of Plant No. 2 from quarters there to Boulanger Slough. The tow consisted of Tow-boat No. 2 (Fury, Launch No. 2 (Mary), Quarterboat 17, and Barges 6, 12, 39, 64, 71, 72, and 84.

In continuation of the project, adopted and partly completed during the season of 1884, work was resumed May 18 at the crossing near head of Island 16. Two pile-dams, 14 and 15 (Sheet 5, survey 1878) were constructed, and the shore protection, opposite Dams 14 and 15 (Sheet 5), at head of Island 16, was extended 800 feet. Dam 14^5, pile-dam from left bank 1,000 feet below Dam 13 (Sheet 5), is 350 feet long and finished to grade of 5 feet above low water of 1864. Dam 15 (Sheet 5), pile-dam from left bank, 996 feet below Dam 14^5, is 400 feet long and finished to grade of 5 feet above low water of 1864. The shore protection on Island 16 is in extension of that previously constructed, and continues up-stream 2,145 feet from the protection built during season of 1884; it is 50 feet wide, and extends to top of bank. The shore protection of the tow-head opposite Dam 14 was repaired over a length of 470 feet.

This work closed June 3, and the following day Plant No 1 and crews were moved to West Saint Paul.

The project for improvement of West Saint Paul Harbor includes one wing-dam from right bank, at foot of Eaton street, 550 feet long, with an extension down-stream from outer end of dam, running parallel with the current for a distance of 1,000 feet, two closing-dams between right bank and Boat Club and Raspberry islands, and protection of the main-channel shore of these two islands.

Operations were begun at West Saint Paul on June 4. The following work has been accomplished to June 30, 1885:

The dam located at foot of, and on prolongation of center line of, Eaton street is 550 feet long; the longitudinal extension is 1,025 feet long, terminating at a point where there is a depth of 4 feet below low water; the dam and extension are to be finished to grade of 5 feet above low water. Closing-dam, between right bank and Boat Club Island, is located about 200 feet below line of Wabasha Street Bridge, 550 feet long, and to be finished to grade of low water; the shore-protections at ends of this dam extend up to the piers of the bridge. Closing-dam from right bank to island above Boat Club Island, located 225 feet from head of the island, is 350 feet long, and is to be finished to grade of low water. These are solid brush and rock dams, and are finished, except covering of rock to bring them up to proper grade. Boat Club Island shore is protected, the work extending from bridge-pier to foot of island, 1,575 feet; the protection is 55 feet wide. The protection of bank of island above Boat Club Island is begun.

The following table shows the materials put in various works:

Works.	Location.	Length.	Rock.	Brush.	Poles.	Linear feet piles.	Linear feet stringers.
		Feet.	*Cubic yds.*	*Cubic yds.*			
Dam 14^5	Left bank	350	490.5	1,146.6	1,000	900	700
Dam 15^5	..do	400	335.7	769.3	700	1,000	900
Shore protection, Island 16	Head of island	2,145	1,771.6	1,636.0	700	....	....
Dam 1	West Saint Paul Boat Club Island	550	374.4	1,619.3	1,300	....	....
Dam 2	Eaton street	1,575	761.1	1,930.9	1,532	....	....
Dam 3	Upper Island or Raspberry Island	350	307.0	840.8	800	....	....
Shore protection	Boat Club Island	1,575	1,346.1	1,826.8	800	....	....
Shore protection	Upper Island or Raspberry Island	....	269.3	1,720.7	400	....	....
Total	....	....	5,655.7	11,490.4	7,232	1,900	1,600

The work in this vicinity has been much delayed, owing to breaking of shaft of Tow-boat No. 1 on June 3. While repairs to shaft were being made Tow-boat No. 2 was put in commission and performed excellent work. Repairs to shaft were finished June 20.

Respectfully submitted.

J. D. DU SHANE,
Overseer.

REPORT OF MR. C. W. DURHAM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., July 1, 1885.

MAJOR: I have the honor to submit the following report of operations for the improvement of the Mississippi River in the division under my charge, extending from Lansing to Montrose, Iowa, for fiscal year ending June 30, 1885.

CASSVILLE SLOUGH AND GUTTENBERG.

The United States snag-boat J. G. Parke, with fleet of barges, was assigned to this work. She was aided at first by the steam-launch Lucia, and later by the steamer-launch Louise.

The snag-boat General Barnard assisted in towing the barges from the canal to the scene of operations, and was then used as a quarter boat until the work was completed, when steam was again raised on her, and she towed a portion of the fleet down river to Fort Madison. The long tow from the canal to Cassville and return somewhat increased the cost of the work.

The Barnard and Parke left the canal on September 3, arriving on the evening of the 10th at Devil's Elbow, in Cassville Slough.

Work was at once begun on the closing dam at Devil's Elbow (2^{32}), and its end shore protections, as well as the protection of the entire shore of Island No. 190. The rock for the work was towed from the quarries below Glen Haven, and a great part of it was gotten out by hired labor.

Almost from the beginning of operations the river began to rise rapidly, and was soon over the banks. It remained high during the remainder of the season, much interfering with the work in every way. It became almost impossible to procure brush, and on that account more rock was used than customary, making the work more expensive.

At the quarries, too, a large quantity of rock, furnished by William Tate, had to be temporarily abandoned, it being covered by water. The dam and shore protections at Devil's Elbow were completed as well as possible, under the circumstances, on October 15.

From October 15 to 18 repairs of Swift Slough Dam (1^{32}) were carried on. These consisted in two courses of rock and brush the entire length of dam, and some additional rock on the low part at the west end.

On the 18th, work on dam across head of McMillan Slough (3^{32}) was begun. The dam was finished October 28.

On the 28th and 29th several barges of rock were put on the shore protection opposite Guttenberg, it needing some repairs.

The fleet then departed for Fort Madison.

SUMMARY OF WORK.

Dam (2^{32}) closing Devil's Elbow, 540 feet long, elevation of crest 6 feet above low water, with shore protections at ends and on Island 190 about 400 feet long.

Dam (1^{32}) closing Swift Slough, two courses of rock and brush laid, and shore protections strengthened.

Dam (3^{32}) closing McMillan Slough, 750 feet long, elevation of crest 6 feet above low water, and shore protection 160 feet in length.

Shore protection opposite Guttenberg, slight repairs.

Table of material.

Works.	Rock.	Brush.
	Cubic yards.	*Cubic yards.*
Devil's Elbow Dam (2^{32})	5,564.4	3,325.2
Swift Slough Dam (1^{32})	537.4	454.2
McMillan Slough Dam (3^{32})	1,415.6	1,160.9
Shore protection opposite Guttenberg	198.3	....
Totals	7,715.7	4,940.3

Aggregate amount of material, 12,656.0 cubic yards.

ESTIMATE OF COST (EXCLUSIVE OF GENERAL SUPERINTENDENT AND OFFICE).

Total expended, as per vouchers	$13,192 07
Add cost Tate rock, paid for previously	1,061 84
Add cost Peterson rock, paid for previously	752 56
	15,006 49
Deduct Parke's expenses in towing barges to Fountain City, say	300 00
Cost of 12,656 cubic yards material	14,706 49
Average cost per cubic yard	1 16

BUILDING DAMS AND SHORE PROTECTIONS VICINITY OF FORT MADISON, IOWA.

In this work the Parke, with fleet of barges, performed the towing, assisted by steam-launch Louise, the Barnard being used as a quarter-boat.

Work was begun November 3 on dam (3^{61}). This dam was completed November

18, its crest being at an elevation of 6 feet above low water. It is 509 feet in length, and closes the chute between Smith's Island and the tow-head.

While work on the dam was in progress the shore protection on head of Smith's Island was strengthened. United States Dredge No. 1 was employed for a few days in putting gravel in the gap in Niota Dike, but gravel being scarce and the water getting too low for safe navigation in the slough the dredge was returned to Montrose.

Amount of gravel put in by the dredge was 1,002 cubic yards, at a cost of about $200

TABLE OF MATERIAL, DAM (3^{61}) CLOSING SMITH'S ISLAND CHUTE, AND SHORE PROTECTION, HEAD OF SMITH'S ISLAND.

	Cubic yards.
Rock	4,391
Brush	989
Total amount of material	5,380

A portion of the brush was brought from Turkey River, Iowa, and the remainder cut in vicinity. All of the rock was brought from the quarries at Nauvoo.

ESTIMATE OF COST (EXCLUSIVE OF GENERAL SUPERINTENDENT AND OFFICE).

Total expended, as per vouchers	$4,537 15
Add value of provisions on hand at beginning of work	150 00
Add Berger rock, previously paid for	638 33
Add Roberts rock, previously paid for	550 00
Add Wiegand rock, previously paid for	348 26
	6,223 74
Deduct subsistence on hand at close	105 00
	6,118 74
Deduct cost of dredging	200 00
Cost of putting in 5,380 cubic yards material	5,918 74
Average cost per cubic yard	1 01

COMBINED STATEMENT FOR CASSVILLE SLOUGH AND FORT MADISON.

Material:	
Total cost of work at both localities	$20,625 23
Total number cubic yards material	18,036 00
Average cost per cubic yard	1 14
Subsistence:	
Total cost of subsistence	2,687 70
Total number of rations	8,036 00
Average cost per ration	33 cents.

VICINITY OF ANDALUSIA, ILLINOIS.

The work proposed at this locality was the construction of a closing-dam (1^{49}) from Island 321 to the Illinois shore, the extension of the shore protection on the head of the island, and the raising of dam (2^{49}).

Work was begun, under contract with A. J. Whitney, of Keokuk, Iowa, on September 15.

The old shore protection, built during season of 1881, was found to be in good condition with the exception of about 50 feet across the mouth of a small slough. The strong and direct current against this part of the riprap had caused it to settle and made the raising necessary. The extension of the riprap was successfully brought to a point 400 feet from the west end and 110 feet from the east end.

After the location of dam (1^{49}) had been established (750 feet below head of Island 321) the shore protection for the west end of it was built 150 feet below and 50 feet above the center line of the dam. The shore at the east end of the dam was not protected in the usual manner on account of its rocky nature and its long and exceedingly shallow slope.

In order to reduce the cost of the dam and increase its stability it was considered advisable to raise the of bed the river on line of dam with gravel, which, under an agreement with the contractor, was dumped in place for 25 cents per cubic yard. For four days one dredge and for the following four days two dredges were engaged in supplying this gravel from a bar at the mouth of Dodge Creek, above the town of Buffalo, Iowa.

The rapid rise of the river made it necessary to confine the dumping of this material to the shallow parts of the proposed line. Some difficulty was experienced in dumping the gravel uniformly, partly on account of the somewhat imperfect handling of the tow-boat, and partly through the nature of the material which, mixed with a certain percentage of mud, dumped slowly and unevenly. After the dredges had been stopped, three sounding lines were run carefully over the dumping-ground. The result showed 65 per cent. of the material to be in place.

The bottom of the river at the site of the dam consists of shelly limestone, with a covering of sand and mud of uneven thickness. The low-water channel is from 500 to 600 feet wide, with an abrupt slope on both sides. On account of the nature of the river bottom it was necessary to use five cribs, 200 feet above the line of the dam and 200 feet apart, for the manipulation of the barges. These cribs were 10 feet long, 5 feet wide, and 4 feet deep, and each contained an average of 5 cubic yards of rock, and proved during the construction of the dam sufficiently secure and strong. Barges for laying the foundation were put in position September 25, and a double layer of brush (from 30 to 35 feet wide) and rock was run over the dumped material with little interruption. In the deeper portion of the channel some difficulty was experienced in sinking the mats properly, which was later overcome by the use of mat-lines 100 feet in length. The Illinois shore was reached with this double stretch October 26. On account of its very gentle slope and the extremely shallow water which prevented the placing of the barges, a gap about 120 feet wide was left between the end of the foundation and the, at that time, edge of the water. A possible deep washing out of this portion was not considered to be of serious consequence, as the rocky bottom of the river would soon check it. The work now progressed fairly well. Four to five layers of mats (50 by 20) in the deeper parts and three in the shallower portions were sunk, and the dam brought up to its proper height of 5 feet above low water on November 3. The up-stream slope of the dam being too abrupt, about 2,000 cubic yards of rock were used for giving it a longer slope and additional strength.

On October 31, owing to the sandy and light character of the soil, a rapid caving-in of the shore protection on the west end of the dam was noticed. With an additional covering of gravel and spalls over the sunken portion the further progress of this caving-in was successfully checked, and in order to force the water away from the shore 40 to 50 feet of the end of the dam was raised to the height of the shore protection.

With the fall of the water and the raising of the dam the current through the gap on the east end had gradually increased to such an extent that the ends of the dam showed signs of being undermined and washed away. For this reason it was considered necessary to close it without delay. The former bottom in the gap had been washed out to the rock bed to a depth of about 5 feet and a width of 120 feet. After three days' work the gap was closed with cribs and rock. November 15 and 16, the last two days of the work, were spent in raising dam (2^{49}) to a height corresponding with that of dam (1^{49}). The length of dam (1^{49}) from shore to shore was found to be about 1,300 feet, and its width at the base from 30 to 40 feet, according to the depth of water. On account of the high stage of water during its construction, which made it impossible to level it properly, its height varies from 5 to 6 feet above low water.

The following quantities of material were used in the construction of this dam.

	Cubic yards.
Rock	8,548.0
Brush	3,298.0
Gravel	7,538.1

The benficial effect of dam (1^{49}) in the lower gap, or Ferry Slough, is already plainly visible.

Mr. H. Bosse, the inspector in charge of the work, is deserving of much credit for good management.

SUMMARY OF OPERATIONS AT ANDALUSIA, SEASON OF 1884.

9,436.6 cubic yards rock, at $1.25	$11,795 75
3,498.1 cubic yards brush, at 70 cents	2,448 67
5,858.5 cubic yards gravel, at 25 cents	1,464 62
1,679.6 cubic yards gravel, at 22 cents	369 51
Engineering contingencies	461 32
Total cost	16,539 87
Deduct cost of gravel	1,834 13
Cost of 12,934 cubic yards rock and brush in place	14,705 74
Average cost per yard	1 14

DREDGING AT CAMPBELL'S CHAIN, ROCK ISLAND RAPIDS.

At the first chain below Hampton, called Campbell's Chain, sand had been forming for some years, both in the cut itself and at and above its head.

An examination made in July, 1884, showed that the channel had filled up on an average of 1.64 feet above grade over its full width and for a length of about 1,250 feet.

An agreement was then made with A. J. Whitney to remove the deposit, which consisted of very light sand, weighing 92 to 96 pounds to the cubic foot, for 18 cents per cubic yard.

Dredging began August 1 and was completed August 26, twenty-two working days.

The amount of sand removed was 10,075.9 cubic yards, a daily average of 458 cubic yards. The material was dumped near Iowa shore opposite the bar. Mr. C. H. Benck was the inspector in charge of the work.

DREDGING IN MUSCATINE HARBOR.

An allotment of $4,500 was made for removing deposits of sand, mud, and bowlders at Muscatine, Iowa, in continuation and completion of work done at that city in former years under special appropriations. An agreement was made with A. J. Whitney, of Keokuk, to perform the work, the price to be paid being 10 cents per cubic yard.

Two dredges were put at work October 13, and completed the same November 22, during which time 44,418.4 cubic yards of material were excavated and dumped on the island shore opposite Muscatine.

Five patches of mud and bowlders were removed, and three cuts were made along the city front from Mulberry street to the coal yards below the elevator.

No further trouble need be expected at this harbor for many years to come.

BUOYS ON ROCK ISLAND RAPIDS.

The buoys, twenty-three in number, placed on the rapids to mark the channel were removed in November, 1884, and stored at Rock Island for the winter. In the spring they were repaired and painted, and twelve new boats and chains were procured. In May, 1885, twelve of the buoys were replaced by the steam-launch Stella. The anchorages of the remainder could not be found at the high stage of water then prevailing, some of them also being covered with sand. The river has not yet reached a sufficiently low stage to permit the placing of the rest of the system.

REPAIRING NIOTA CAUSEWAY AND DREDGING IN THE HARBOR OF FORT MADISON IOWA.

The United States tow-boat Vixen was put in commission in April, 1885, and sent with a fleet of barges and dredge No. 1 to Fort Madison. The work proposed was the closing of a gap in the Niota Causeway and the removal of the mud deposit at the steamboat landing at Fort Madison.

The fleet, including the steam-launch Louise, left Keokuk on the 15th. The gap in the causeway, which is used by the ferry company, was about 200 feet in width, and in the central part about 30 feet in depth at a 6 foot stage. It was proposed to use as much gravel as possible, and only sufficient rock to make a suitable road-bed.

The dredge which was placed on a gravel bar a short distance below the causeway furnished gravel on dump-boats which were towed by the launch Louise to the break.

Early in May the current in the gap becoming very strong, the dumping of gravel was abandoned and the causeway was brought up to grade with rock and spalls. Several weak places were strengthened, and when work was completed, June 2, the road-bed was in good condition for its whole length of about 700 feet, 20 feet wide, and at an elevation of 7 feet above low water, and some 400 feet of substantial shore protection had been constructed at the western end.

A large break having occurred in the eastern end of dam (1^{61}) which closes Niota Chute (or rather the shore having cut away from that end), it was determined to close it to avoid the loss of the remainder of the dam and the great damage to navigation which would ensue if the channel should change to Niota Chute. Gravel was dumped in the break, which was about 150 feet long and in places 33 feet deep, until the dam was brought nearly to grade, when rock was used for a covering and to level up inequalities.

The shore protection, about 300 feet long, was built principally of gravel.

On the 21st of May the dredge was removed to Fort Madison and employed until June 9 in removing the sand and mud deposits from the steamboat landings.

An area 400 feet long by 150 feet wide was dredged over and material removed to a depth of 4 feet below low water. While the above work was going on, some repairs were made to the shore protection on Smith's Island, and the dam (2^{61}) was raised about 2 feet, and the shore protection at its west end was strengthened. On June 10 the fleet was taken to Keokuk and laid up in the canal.

Table of materials.

Locality.	Rock.	Brush.	Gravel.	Total material.
	Cub. yards.	*Cub. yards.*	*Cub. yards.*	*Cub. yards.*
Niota Causeway, repairing break	3,523.2	283.5	5,647.7	9,454.4
Dam (1^{61}) and shore protection	365.7	....	7,634.2	7,999.9
Dam (2^{61}) and shore protection	968.4	....	....	968.4
Smith's Island shore protection	734.1	....	....	734.1
Total	5,591.4	283.5	13,281.9	19,156.8

The amount of sand and mud removed from the steamboat landings was 8,306.8 cubic yards.

During the latter part of June the General Barnard, having been repaired and outfitted, was, in company with steam-launch Louise, sent to Fountain City, Wis., to operate in that vicinity. They arrived at that point on June 30.

Very respectfully, your obedient servant,

C. W. DURHAM,
Assistant Engineer.

Maj. A. MACKENZIE,
Corps of Engineers, U. S. A.

REPORT OF MR. G. A. MARR, ASSISTANT ENGINEER.

STOCKHOLM, WIS., *June* 30, 1885.

SIR: I have the honor to submit the following report on field and office work while under your direction and since my semi-annual report of December 31, 1884, till taking charge of work here on harbor of refuge May 23, 1885.

In January the maps of the Guttenberg survey were completed, and, with field notes, forwarded to Rock Island office. Maps of all surveys and examinations made during season of 1884, after August, were completed, and full tracings made both for special reports and as duplicates for the Saint Paul office. During the month of March examinations were made on the ice, the one at foot of Nininger Slough extending over about one mile of river, and the one at Red Rock being over half a mile. The examination at foot of Nininger Slough showed but little change since the last examination. The crossing at Red Rock had been very much improved by Dams 17^2 and 18^2, and there seemed to be a well-defined channel at that point. Special reports were made on these examinations at Winona, and at the ponton railroad bridge at Reed's Landing, Minnesota. The examination at Winona did not reveal any such serious changes in the condition of the levee as had been reported.

In fact, a comparison with the survey of 1878 showed but very little change, much less than at almost any other point on the river. At the ponton bridge at Reed's Landing very serious changes were found, a large sand-bar having formed directly above the ponton opening, with the heavy draught of water passing 200 or 300 feet to the north of the ponton. This would lead to a continual shoaling at the ponton opening. Floats were sent down from about 1 mile above the bridge, and their paths plainly showed the strong current leading to the north of the ponton and almost directly through the 100-foot span to the north of the ponton.

On April 10 I made an inspection of the new hull being built for United States towboat No. 1, South Stillwater, the contractor, Mr. J. Batchelder, having asked for an advance of funds, the amount of $1,200 being allowed on a contract for $2,600.

The usual large sheets of tabulation for the field for work, season of 1884, were prepared, and such copying and other general office work done by Mr. J. F. Marr and Mr. J. S. Whiting, who have also ably assisted with all the mapping and making of tracings during the season, as well as with the field work of examination at Nininger and Red Rock.

When the dredging of West Saint Paul Harbor, under contract of March 25, 1885, with Mr. C. H. Appleton, was commenced on May 6, Mr. J. F. Marr was placed in charge of the work under your direction, and since then has reported directly to you. A tracing from map of survey of 1883 from Saint Paul to Pig's Eye Island was prepared for Mr. C. H. Appleton to give outline of dumping-grounds for material dredged from the river at West Saint Paul.

Mr. J. S. Whiting was assigned to me for duty at Stockholm, Wis., on the contract work of Mr. H. E. Stevens for harbor of refuge on Lake Pepin, and has been on this work since May 27, 1885.

Very respectfully,

G. A. MARR,
Assistant Engineer.

A. MACKENZIE,
Major of Engineers, U. S. A.

Z 3.

IMPROVEMENT OF THE MISSISSIPPI RIVER FROM DES MOINES RAPIDS TO THE MOUTH OF THE ILLINOIS RIVER.

There was available under this head of appropriation at the beginning of the fiscal year the sum of $12,663.38, and a further appropriation of $200,000 was made by act of July 5, 1884.

Work under the last-mentioned appropriation was to be "expended under the direction of the Secretary of War in accordance with the plans, specifications, estimates, and recommendations of the Mississippi River Commission." Under date of July 14, 1884, I submitted a project for the expenditure of a portion of this appropriation, which project was approved by the commission.

The work was transferred to Capt. E. H. Ruffner, Corps of Engineers, September 1, 1884.

During 1883 Patterson Brothers, of Keokuk, under contract with the United States, carried on the construction of dams and shore protections in vicinity of Louisiana, Mo., which work was fully reported in my annual report for year ending June 30, 1884. In the spring of 1884 an agreement was made with the same parties to continue work at Louisiana at former contract prices, the work contemplated being the repair of dams already built and the further protection of the shores of Buffalo Island. Operations commenced August 8 and continued until transfer of work September 1; 2,822.45 cubic yards of rock and 1,912 cubic yards of brush were put in during the month of August.

The project, under appropriation of July 5, 1884, contemplated the continuation of improvements in vicinity of Louisiana, $30,000 being allotted for the work. It was proposed in the construction of dams to make use of gravel for a foundation, and in accordance therewith an agreement was made with Mr. H. S. Brown, of Quincy, to put in gravel for the closing-dam at Brokan Island for 25 cents per cubic yard. Mr. Brown began work August 12, and up to date of my transferring the work had put in place 4,323.59 cubic yards.

The project also included a continuation of the work of improvement, begun the previous year, between Canton and La Grange. This work consisted in the construction of dams and shore protections and dredging of new channels.

The principal material used for dam construction was gravel. Work was begun August 11, a large dredge and two tow-boats being used in raising wing-dam (366) and constructing a closing-dam behind Island No. 420. Up to date of transfer there had been placed in the spur-dam 5,094 cubic yards of gravel and in the closing-dam 396.2 cubic yards brush, 1,388 feet of frame-work, 835 linear feet of bulkhead, 2,268 linear feet piling, 148 cubic yards rock, and 6,953 cubic yards gravel. The closing-dam referred to was experimental, and was composed of a bulkhead supported by piling, which checked the current, and gravel, which was deposited on upper and lower sides of bulkhead. The opening to be closed was 928 feet in length, and no difficulty was experienced in constructing 700 feet of the dam, but the concentration of the water rendered the current so swift through the remaining 200 feet that piles, gravel, &c., would not stand, and rock had to be used. This work was transferred before completion to Captain Ruffner.

The act of July 5, 1884, under this title of appropriation, provided for continuing work of dredging in Quincy Bay. An allotment of $12,500 was made for this work, and a contract was entered into with Mr. H. S. Brown at 14 cents per cubic yard. No work had been done up to time of transfer to Captain Ruffner.

Under date of March 19, 1885, I applied through the Chief of Engineers for an allotment of $5,000 for snagging and wrecking between Des Moines Rapids and the mouth of the Illinois River.

My application was approved by the Secretary of War, the Chief of Engineers, and the Mississippi River Commission, and the allotment was granted April 2, 1885. A portion of the sum has been expended in care and repair of snag-boat General Barnard; the remainder will be used in removing snags, wrecks, &c., later in the season, when the river reaches a low stage.

ABSTRACT OF APPROPRIATIONS.

By act approved June 18, 1878	$100,000
By act approved March 3, 1879	40,000
By act approved June 14, 1880	100,000
By act approved March 3, 1881	175,000
By act passed August 2, 1882	*200,000
By act approved July 5, 1884	200,000
	815,000

Money statement.

July 1, 1884, amount available	$12,663 38
Amount appropriated by act approved July 5, 1884	200,000 00
	212,663 38
July 1, 1885, amount expended to September, 1884, exclusive of outstanding liabilities July 1, 1884	22,176 99
September 1, 1884, amount available, transferred to Capt. E. H. Ruffner, September, 1884	190,486 39
April 5, 1885, amount allotted for snag-boats	5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	675 50
July 1, 1885, amount available	4,32i 50

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*Appropriated under head of "Improving Mississippi River," * * * "from the Illinois River to Des Moines Rapids."

Abstract of proposals received and opened by Capt. E. H. Ruffner, Corps of Engineers, Rock Island, Ill., at 2 p. m., September 5, 1884, for dredging in Quincy Bay, Illinois.

No.	Names and residences of bidders.	For dredging and removing material to a distance not exceeding one mile. (Approximate quantity, 15,000 cubic yards, per cubic yard.)	For dredging and removing material to a distance exceeding 1 mile and not exceeding 2½ miles. (Approximate quantity, 45,000 cubic yards, per cubic yard.)	Total.
1	J. W. Heirsey, Burlington, Iowa	$0 15	$0 21	$11,700 00
2	C. S. Whitney, Keokuk, Iowa	19⅞	21	12,421 25
3	C. L. Williams, Keokuk, Iowa	14	14	8,400 00
4	A. J. Whitney, Keokuk, Iowa	12	15	8,550 00
5	H. S. Brown, Quincy, Ill	14	14	8,400 00
6	B. E. Linehan, Dubuque, Iowa	22	23	13,650 00

NOTE.—The above proposals were received in response to advertisement of Maj. A. Mackenzie, Corps of Engineers, dated August 5, 1884.

Abstract of all proposals received and opened this 5th day of September, 1884, at 2 p. m., by Capt. E. H. Ruffner, Corps of Engineers, at Rock Island, Ill., for constructing dams and shore protections of brush and rock in vicinity of Louisiana, Mo.

No.	Names and residences of bidders.	10,000 cubic yards stone.		8,000 cubic yards brush.		Aggregate.
		Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	
1	Fruin, Bambric & Co., Saint Louis, Mo	$1 49	$14,900	$0 80	$6,400	$21,300
2	H. McPherson & Co., Boonville, Mo	1 49	14,900	85	6,800	21,700
3	C. S. Whitney, Keokuk, Iowa	1 35	13,500	90	7,200	20,700
4	A. J. Whitney, Keokuk, Iowa	1 49	14 900	80	6,400	21,300
5	H. S. Brown, Quincy, Ill	1 40	14,000	91	7,280	21,280
6	Patterson Bros., Keokuk, Iowa	1 35	13,500	65	5,200	18,700

NOTE.—The above proposals were received in response to advertisement of Maj. A. Mackenzie, Corps of Engineers, dated August 5, 1884.

Z 4.

CONSTRUCTING HARBORS OF REFUGE ON LAKE PEPIN, AT STOCKHOLM, WISCONSIN, AND LAKE CITY, MINNESOTA.

A survey of proposed sites, called for by Congress, was made in November and December, 1881, and report and project were submitted February 13, 1882.

The act passed August 2, 1882, appropriated $20,000 for constructing harbors of refuge, $10,000 to be expended at Stockholm and $10,000 at Lake City.

The works proposed, being necessarily located in exposed positions and in comparatively deep water, are expensive, and it was not deemed prudent to commence work until a sufficient amount of money was available to make it safe. My report for fiscal year ending June 30, 1883, stated as follows:

> My report and project for these works presented plans for piers, which would facilitate the landing of boats and shipment of freight. The cost of work given was the minimum with which any good results could be secured. Smaller amounts can be expended, but I should be unwilling to recommend such expenditures until an appropriation of the entire amount guarantees work which will benefit the interests of navigation.
>
> As stated in my report to secure the full benefits of harbors of refuge and protect the raft interest, the work suggested must be greatly extended.
>
> As the act under which these examinations were made did not, as did act of August 2, 1882, call for or permit an expression of opinion as to the public necessity for this work, I contented myself with simply presenting in report, and attached letters and statistics, opinions of those practically engaged in navigation.
>
> Should Congress deem it expedient on the evidence produced to continue appropriations for this work it would, in my opinion, be desirable that an expression be given as to what appropriations may be expected in future, and to the extent to which the work is eventually to be carried.
>
> These works are located in exposed positions in deep water, and in case of failure of appropriations previous to completion to at least the extent contemplated in project presented, all work done previous to completion might be lost.

Congress has not in the case of these harbors given any definite orders as to the amount of work which is justified by the interests involved, but it may be properly assumed that the work desired is proportionate to the appropriations made. Adopting this view, an amended project for work at Stockholm was presented August 21, 1884. It was at that time, for reasons given, proposed to purchase material, under sealed proposals, and perform the work by days' labor. The bids for material received being exorbitant were all rejected.

On March 17, 1885, a second project was presented, which recommended the carrying out of work by formal contract. This recommendation was approved, and the work was advertised and awarded to the lowest bidder, Mr. H. E. Stevens, of Saint Paul. Work under this contract was commenced in the latter part of May, and is still in progress.

It contemplates the construction of a crib pier extending from the sand point below town about 500 feet into the lake and built up to the plane of high water.

It is thought that this pier will furnish protection on one side or the other at nearly all times. The work accomplished during the year is as follows: The construction of earthen approach 135 feet in length, and protection of same by riprap; the construction, placing, and filling of seven cribs, 32 feet long by 20 feet wide, and building a portion of the superstructure for the same.

Operations are under the immediate supervision of Mr. G. A. Marr, assistant engineer.

Previous reports on this work have given amounts required for completion of existing project, based on the survey and report submitted February 13, 1882. But, as has been stated, no expression has been given as to the extent to which it is contemplated to carry on the work.

As the work now stands, and basing it on the appropriations in sight, I would call the existing project that of gradually constructing piers at Stockholm and Lake City in extent sufficient to answer present needs of commerce and navigation.

The amounts now on hand may, under modified plans, possibly be sufficient to accomplish this result at Stockholm, at least, where the water is not so deep as at Lake City. No appropriation is, therefore, asked for for the next fiscal year, it being advisable, for further consideration of the subject, to wait until the results of work now going on are fully shown.

If additional appropriations become necessary, a new and more extended project can be recommended. No work has been done at Lake City, and it is proposed to delay such work until the pier now being constructed at Stockholm has been tested as to its strength and capacity for resisting attacks of ice and storms. The sand point which forms a natural breakwater at Lake City renders this delay possible and comparatively unimportant, so far as interests of through navigation is concerned.

ABSTRACT OF APPROPRIATIONS.

By act passed August 2, 1882, of which $10,000 for Stockholm and $10,000 for Lake City	$20,000
By act approved July 5, 1884 ($15,000 for each harbor under different heads of appropriation)	30,000
	50,000

Money statement.

July 1, 1884, amount available		$20,000 00
Amount appropriated by act approved July 5, 1884		30,000 00
		50,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,844 02	
July 1, 1885, outstanding liabilities	324 68	
		4,168 70
July 1, 1885, amount available		45,831 30

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, at Rock Island, Ill., at 2 p. m. on April 30, 1885, for construction of breakwater at Stockholm, Wis.

No.	Names and residences.	Logs, 12,206 linear feet.		Square timber, 250,000 feet, B. M.		Deck plank, 30,000 feet, B. M.		Pocket plank, 25,000 feet, B. M.		Treenails, 4,000 pieces.		Gravel and earth, 5,500 cubic yards.		Rock, 5,000 cubic yards.		Spikes, 100 pounds.		Bolts, price per 100 pounds.	Total.
		Price per linear foot.	Amount.	Price per M, B. M.	Amount.	Price per M, B. M.	Amount.	Price per M, B. M.	Amount.	Price per 100.	Amount.	Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	Price per 100 pounds.	Amount.		
1	David C. Shepard, Saint Paul, Minn	$0 20	$2,441 20	$25 00	$6,250	$25 00	$750	$20 00	$500 00	$10 00	$400	$0 50	$2,750	$3 00	$15,000	$4 00	$40 00	$6 00	$28,131 20
2	George W Robinson, Stillwater, Minn	26	3,173 56	36 00	9,000	25 00	750	17 50	437 50	4 00	160	45	2,475	1 23	6,150	4 00	40 00	5 25	22,186 06
3	James Mathews, Stillwater, Minn	10	1,220 60	26 00	6,500	19 00	570	15 00	375 00	6 00	240	39	2,145	1 20	6,000	6 00	60 00	5 00	17,110 60
4	H. E. Stevens, Saint Paul, Minn*	13¾	1,678 32	23 40	5,850	17 50	525	12 50	312 50	5 00	200	25	1,375	1 00	5,000	4 33	43 30	4 15	14,984 12
5	Patrick H. Thornton and La Fayette Shaw, Saint Paul, Minn	18	2,197 08	21 50	5,375	16 70	501	15 90	397 50	9 90	396	37	2,035	1 23	6,150	9 75	97 50	22 25	17,149 08
6	E. C. Long & Co., Saint Paul, Minn	16	1,952 96	19 00	4,750	17 00	510	16 00	400 00	7 00	280	26	1,430	1 24	6,200	3 50	35 00	7 00	15,557 96
7	Sid J. Truax, Hastings, Minn	25	3,051 50	21 00	5,250	20 00	600	15 00	375 00	3 00	120	39	2,145	1 00	5,000	5 00	50 00	5 00	16,591 50
8	A. J. Whitney, Keokuk, Iowa	12	1,464 72	26 00	6,500	12 00	360	5 00	125 00	3 00	120	45	2,475	1 29	6,450	5 00	50 00	6 00	17,544 72
9	Patterson Bros., Keokuk, Iowa	14	1,708 84	26 00	6,500	11 00	330	10 00	250 00	2 50	100	40	2,200	1 50	7,500	2 50	25 00	3 00	18,613 84

*Accepted; written contract made.

Z 5.

REMOVAL OF BAR IN MISSISSIPPI RIVER OPPOSITE DUBUQUE, IOWA.

Excepting occasional surveys and examinations no work has been carried on under this head of appropriation during the past year, as no trouble was experienced.

There is a balance of $7,141.82, which will be expended during present year, if examinations, to be made when the river is low, show the same to be necessary.

As subsequent projects under limited appropriations have entirely modified the original project for this work, it is proper to omit the amount which has heretofore been given as required for completion of existing project. As this work now stands, it amounts to simply doing as much as circumstances require and funds permit. If additional work is imperatively demanded it can be provided for by allotments from the general appropriation.

No further appropriation is asked for.

ABSTRACT OF APPROPRIATIONS.

By act approved August 14, 1876	$15,000
By act approved June 18, 1878	10,000
By act approved March 3, 1879	4,000
By act approved June 14, 1880	7,000
By act approved March 3, 1881	5,000
Total	41,000

Money statement.

July 1, 1884, amount available	$7,276 92
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	135 10
July 1, 1885, amount available	7,141 82

Z 6.

ICE-HARBOR AT DUBUQUE, IOWA.

In accordance with instructions contained in an indorsement dated Office Chief of Engineers, December 24, 1880, on a letter addressed to the Secretary of War by Hon. Thomas Updegraff, I submitted, under date of December 31, 1880, a report upon the establishment of an ice-harbor at Dubuque, Iowa. This report is printed with maps as House Ex. Doc. No. 49, Forty-seventh Congress, first session.

The work contemplated by this report was the deepening by dredging of Waples Cut over an area of 502,000 square feet, the riprapping of First street, which forms the southern boundary of harbor, and the construction of a sluice-way through the Third street embankment. The probable cost of this work was placed at $40,000.

An appropriation of $20,000 for commencing work was made by act of Congress passed August 2, 1882, and a contract for dredging was entered into with B. E. Linehan, of Dubuque, at 19¾ cents per cubic yard. There was removed under this appropriation 92,795 cubic yards of material, giving a depth of 6 feet at low water over an area of 390,960 square feet.

In October, 1882, the city council of Dubuque passed a resolution reciting the fact that the city of Dubuque had acquired title to the land surrounding the site of the proposed ice-harbor and donating the same for use in perpetuity in connection with an ice-harbor. An official copy of this resolution was forwarded to me, and it led me in my report for fiscal year ending June 30, 1884, to recommend a modification of project "so as, with but a small increase of cost, to secure an additional area of 164,000 square feet, together with a strip of ground 60 feet in width, to be used as a landing, said strip extending along the north side of the levee as now proposed."

The modified project required the additional dredging of 123,159 cubic yards of sand, the riprapping of the proposed shore, and a quantity of piling for mooring purposes. The additional expense was estimated at $10,000.

The act of Congress approved July 5, 1884, appropriated $20,000 for completing the ice-harbor. Under this appropriation a contract dated September 8, 1884, was made with A. J. Whitney for dredging at 11 cents per cubic yard, a portion of the material to be removed from harbor, and a portion to be placed in embankment on the north side. Owing to high stage of water, which was unfavorable for placing material in embankment, and the necessity for using the dredges elsewhere, but little work was carried out during year 1884. In December an attempt was made by the contractor to move material with scrapers and wagons, but after placing 2,728.3 cubic yards in embankment, work was suspended until April, 1885. Since that time dredging has been continued, 57,747.8 cubic yards having been removed from the harbor and 13,022.2 cubic yards placed in embankment. The dredging work contemplated under Mr. Whitney's contract will be completed in a very short time.

Under date of December 31, 1884, I received a letter from the mayor of Dubuque informing me that "the grant to the city of the property reads as follows:"

> The portion of the premises and property hereby conveyed lying and being south of Third street to be used in perpetuity as an ice-harbor, and on the north of said ice-harbor, adjacent to the lots on the south side of Third street, there shall be a levee not less than 100 feet wide, the same making the north boundary of said ice-harbor.

And under date of May 21, 1885, I received a letter from the city engineer of Dubuque inclosing a plat showing certain ice-harbor boundaries, and informing me that the city council in its session of May 11, 1885, passed the following resolution:

> That the plat of ice-harbor prepared by city engineer, and this day submitted to the city council, showing the boundaries of said ice-harbor and levees reserved on the north, west, and south sides of the same, is hereby approved and adopted.

The plat shows levees on the north and west side, with slopes of about 20 to 100 and 20 to 70 on the south side of ice-harbor.

The information given me in the letter of the Mayor and City Engineer here referred to was not in my possession at the time my plans and projects were made. My plans, which were based on necessities of commerce, verbal communications with the Mayor and others in Dubuque, and on the official copy of resolutions of council furnished me in October, 1882, which did not contain the clause given in the Mayor's letter, are somewhat affected by the changes in boundaries, &c., lately made. My recommendations and plans were for the construction of an ice or winter harbor, and had no relation to ordinary harbors, such as are required by a city for accommodating its river commerce. The main part of the plan was for dredging and giving sufficient depth over a sufficient area to accommodate such boats as desired to winter in the Dubuque Harbor. I included certain riprap work, on the theory that the borders of the ice-harbor would be of such a slope as to need riprapping for protection. I also included the filling up of the 60-foot strip on north side of harbor, because the material was on hand to build it, and cost but little more to place in embankment than to remove and dump in the river.

The establishment of levees or landing-places all around the ice-harbor converts it into a ordinary harbor, and the gradual slope given these levees does away with any necessity for the riprap work originally proposed.

There remains but little for the Government to do, as the case now stands, to complete all work which is necessary for placing this harbor in such condition as will make it serviceable for the use of boats as a refuge during the winter.

All dredging will be completed in a short time, giving a depth of 6 feet over the whole area available, and in the fall groups of piles, against which boats can be moored, will be driven. Plans showing the modified project as it then existed are given in the Report of Chief of Engineers for 1884, page 1572. The harbor, as completed, will have an area of 580,000 square feet.

The changes herein referred to and the low price at which dredging has been carried out renders it unnecessary to ask for any further appropriation, the balance on hand being sufficient to complete the work.

SUMMARY OF WORK DURING FISCAL YEAR ENDING JUNE 30, 1885.

13,022.2 cubic yards material placed in embankment, at 11 cents	$1,432 44
57,747.8 cubic yards material dumped in river, at 11 cents	6,352 26
Surveys, engineering, and contingencies	960 50
Total	8,745 20

ABSTRACT OF APPROPRIATIONS.

By act passed August 2, 1882	$20,000 00
By act approved July 5, 1884	20,000 00
Total	40,000 00

Money statement.

Amount appropriated by act approved July 5, 1884		$20,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,967 33	
July 1, 1885, outstanding liabilities	778 47	
		8,745 80
July 1, 1885, amount available		11,254 20

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, Rock Island, Ill., at 2 p. m. September 5, 1884, for ice-harbor construction at Dubuque, Iowa.

No.	Names and residences of bidders.	Price per cubic yard for excavating and depositing in embankment. (Approximate quantity, 35,000 cubic yards.)	Price per cubic yard for excavating material and depositing at a distance not to exceed one mile. (Approximate quantity, 40,000 cubic yards.)	Total amount.
		Cents.	*Cents.*	
1	C. H. Booth, Dubuque, Iowa	21	16	$13,750
2	J. W. Heisey, Burlington, Iowa	25	20	16,750
3	C. H. Appleton, La Crosse, Wis	33	17½	18,550
4	C. L. Williams, Keokuk, Iowa	14	14	10,500
5	A. J. Whitney, Keokuk, Iowa	11	11	8,250
6	B. E. Linehan, Dubuque, Iowa	26	12½	14,100

Z 7.

IMPROVEMENT OF ROCK ISLAND RAPIDS, MISSISSIPPI RIVER.

No funds were available for work under this head of appropriation during the past fiscal year.

The only work attempted was the removal of sand from the cut at Campbell's Chain and the placing, care, and removal of buoys. This work was paid for by an allotment from the general appropriation for improving Mississippi River from Saint Paul to Des Moines Rapids.

There still remaining a few points in the channel above grade, it cannot be said that this work has yet been completed in accordance with existing project, but as the amount of work required to so complete project is small, it is practicable to provide for such work by allotment from a general appropriation for the upper river, and therefore no appropriation is asked for for the next fiscal year.

The present channel at the Rock Island Rapids is supposed to be 4 feet deep at low water, with a minimum width of 200 feet.

As has been stated in previous reports, this channel, to satisfy the needs of navigation, should be at least 400 feet wide, and not less than 6 feet deep. The subject is referred to at length in a special report, printed as House Ex. Doc. No. 67, Forty-sixth Congress, second session, and is given on page 1537, Report of Chief of Engineers for 1880.

Experience has shown that to preserve uninterrupted navigation on the rapids constant care and watching are necessary. Buoys are liable to be carried away and must be replaced; sand and loose rock, bowlders, snags, &c., are liable to be brought into the channel by ice and the current. Such obstructions, if not removed by natural or other causes, may, at extreme low water, cause an entire suspension of navigation. To provide for the care of the Rock Island Rapids, the work should be placed on the same basis as the Government canal at Keokuk and some other works. The annual expense of caring for the rapids would, if no other work of improvement were going on and no excessive amount of dredging were necessary, be about $5,000 per year. In connection with other works of improvement this amount could be materially reduced.

The data for a final report and history of the work of improving Rock Island Rapids has been collected, and it is hoped that this report may be completed and submitted during the coming winter.

ABSTRACT OF APPROPRIATIONS.

By act approved June 23, 1866	$100,000
By act approved March 2, 1867	200,000
By allotment from appropriation July 25, 1868	156,000
By allotment from appropriation April 10, 1869	133,650
By act approved July 11, 1870	150,000
By act approved March 3, 1871	150,000
By act approved June 10, 1872	50,000
By act approved March 3, 1873	50,000
By act approved June 23, 1874	50,000
By act approved March 3, 1875	50,000
By act approved August 14, 1876	25,000
By act approved June 18, 1878	30,000
By act approved March 3, 1879	6,000
By act approved June 14, 1880	8,000
By act approved March 3, 1881	8,000
Total	1,166,650

Z 8.

IMPROVEMENT OF HARBOR AT ROCK ISLAND, ILLINOIS.

An indorsement dated Office Chief of Engineers, September 13, 1879, on a letter addressed by citizens of Rock Island, Ill., to Hon. T. J. Henderson, called for a report upon the condition of Rock Island Harbor. No funds being available for a survey, a simple examination was made and a report was submitted under date of November 5, 1879. In accordance with a resolution of the House of Representatives dated January 25, 1880, the report above referred to was submitted to the House of Representatives by the Secretary of War and is printed as Ex. Doc. No. 32, Forty-sixth Congress, second session. The following extracts from the report show the condition of harbor at time of examination and the work suggested:

> It will be seen that shoal water extends along the entire city front, and that the bar extending down from the foot of Rock Island has so encroached on the wharf as to leave little room for low-water navigation. * * * If any work is to be done, I would recommend the removal by dredging of deposits along wharf, amounting to about 19,000 cubic yards, and the removal of as much of the bar on lines parallel to the current as an appropriation will permit.

The approximate cost of removing deposit and bar, based on the examination made, was given as $26,759.15; subsequently it was discovered that much of the material forming the bar and obstructions along the wharf was rock and stiff clay, and that no assistance could be expected from wash of current, and that if the entire removal of bar &c., was desired a much larger expenditure than at first contemplated would be necessary.

The act of Congress approved June 14, 1880, appropriated $6,000 for this work, and a further appropriation of $6,000 was made by act of Congress approved March 3, 1881.

Work of dredging along wharf and on bar was commenced August 23, 1880, and continued until October 9, 1880, under contract with Whitney & Son. The contract was let on the basis of sand excavation at the rate of 20 cents per cubic yard. Subsequently, when the hard class of material was discovered, the contract was amended by allowing the contractor an increased price for the harder material.

During the year 1880 the work accomplished was as follows:

3,959.30 cubic yards material dredged, at 20 cents	$791 86
1,699.72 cubic yards material dredged, at 50 cents	849 86
1,743.10 cubic yards material dredged, at 66 cents	1,150 45
127½ hours' service of dredge on rock work, at $10 per hour	1,275 00
	4067 17

In 1881, between August 30 and September 5, the contractors, Whitney & Son, were again employed to remove rock along the landing at the rate of $10 per hour for use of dredge and plant. The work accomplished was as follows:

407 cubic yards, at a cost of $690.

There appearing no urgent necessity for work, and the limited number of dredges available being needed elsewhere, no further action was taken with regard to this improvement until the spring of 1884, when an examination was made. This examination showed that the bar was slowly closing in on the shore, and it was thought advisable to expend the balance available. A project was submitted July 14 and approved. The work was advertised and a contract let to the lowest bidder, A. J. Whitney, at the rate of 11½ cents for material removed from bar, and $10 per hour for use of dredge for work on river-front. Work was commenced August 27, and completed October 11, 1884. The work accomplished was as follows:

18,558.6 cubic yards dredged, at 11 cents per cubic yard	$2,134 24
353 hours and 58 minutes' service of dredge, at $10 per hour	3,539 66
Engineering and contingences	595 77
	6,269 67

The total amount expended to date has been $12,000.

It cannot really be said that there is any existing project for this work. No plans or estimates founded on accurate surveys have ever been made. The original report only recommended an amount of work proportionate to any appropriation which Congress might consider proper to make. The harbor is at present in comparatively good condition, much better in fact than that of most harbors on the river.

No further appropriation is asked for, and I am of the opinion that there is at present no special existing project which requires further reports upon this harbor, and therefore I submit this as a final report under this head of appropriation.

ABSTRACT OF APPROPRIATIONS.

Bp act approved June 14, 1880	$6,000
By act approved March 3, 1881	6,000
	12,000

Money statement.

July 1, 1884, amount available	$6,269 67
July 1, 1885, amonut expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,269 67

Abstract of proposals received and opened by Maj. A. Mackenzie, Corps of Engineers, Rock Island, Ill., at 2 p. m., August 23, 1884, for dredging in the Mississippi River—Harbor at Rock Island, Ill.

No.	Names and residences of bidders.	Dredging and depositing materials (20,000 yards) at a distance not to exceed 1 mile.		For use of dredge and plant, 200 hours.		Total.
		Per yard.	Amount.	Per hour.	Amount.	
		Cents.				
1	B. E. Linehan, Dubuque, Iowa	22	$4,400	$9 50	$1,900	$6,300
2	A. J. Whitney, Keokuk, Iowa	11½	2,300	10 00	2,000	4,300
3	H. S. Brown, Quincy, Ill	25	5,000	12 00	2,400	7,400
4	C. S. Whitney, Keokuk, Iowa	23	4,600	8 00	1,600	6,200

Z 9.

IMPROVEMENT OF THE DES MOINES RAPIDS, MISSISSIPPI RIVER.

A brief history of this work is given in my last annual report. The work of the past year has consisted in a continuation of the protection of the canal embankment by riprap, the completion of the raising of the wing-walls at the foot of the canal, the dredging of rock from the open canal between Nashville and Montrose, and repairs to portions of the plant belonging to the appropriation. The quantities and further details are given in the appended report of Mr. M. Meigs, United States civil engineer.

The face stone, backing, riprap face, and rubble, used for raising walls and protecting embankment, were procured from Patterson Bros., of Keokuk, under formal contract and at the lowest prices ever secured for work on the Des Moines Rapids Canal. The laying of stone was performed by days' labor and use of Government tools and appliances. There remains to be done to finish this work, according to existing project, the completion of protection of embankment, the raising of the lock-walls at middle and lower locks, and the building of two additional cribs to facilitate entrance to the canal from above. For reasons given in my last annual report, and again referred to in Mr. Meigs's report, there is added to the existing project an item of $40,000 for building sluice-ways in canal embankment opposite Lamallee's and Price's creeks, and $5,000 for constructing an office at the lower lock. Available balances of appropriations will be used during the coming year for continuing bank protection, arranging for raising lock-walls, and constructing the additional cribs.

It is desirable that this work should be completed, and as such completion will reduce the expenses of operating and care of canal, the appropriation at once of the entire amount required will be a measure of economy.

The act approved July 5, 1884, under items for "Improving Des Moines Rapids," made the following provision:

> Of which sum ten thousand dollars are to be used in the construction of a pier at the outer wall of the Des Moines Rapids Canal in accordance with the recommendation of the Engineer Corps: *Provided*, That said pier shall not be made unless the Secretary of War shall decide that the railroad bridge at that place was built in conformity with the act of Congress authorizing its construction.

This matter was presented to the Secretary of War by the Bridge Company, and through the Engineer Department was referred to me for report, which was submitted under date of November 30, 1884. By letter of the Chief of Engineers, dated February 16, 1885, I was furnished with the following copy of the decision of the Secretary of War:

> The Secretary of War decides that the railroad bridge referred to in the within papers was built in conformity with the act of Congress authorizing its construction.

This decision makes available the $10,000 item in the river and harbor act of July 5, 1884, but as yet it has been impracticable to commence the work. The recommendations referred to by Congress are probably those for a solid crib pier. To construct a portion of this work would increase rather than diminish the trouble. Nothing should be attempted until funds are available for completing the work. But the plans can be modified by substituting a floating boom for the solid crib-pier so as to accomplish good results with the money now available and a project for the expenditure of $10,000 will be submitted if no further appropriation be made available.

Money statement.

July 1, 1884, amount available		$2,932 97
Amount appropriated by act approved July 5, 1884		50,000 00
		52,932 97
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$21,666 08	
July 1, 1885, outstanding liabilities	879 74	
		22,545 82
July 1, 1885, amount available		30,387 15
Amount (estimated) required for completion of existing project		56,745 00
Amount added for completion of modified project		45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		101,745 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstracts of all proposals received and opened this 5th day of September, 1884, *at* 2 *p. m., by Maj. A. Mackenzie, Corps of Engineers, for furnishing stone for use at the De Moines Rapids Canal.*

No.	Names and residences of bidders.	175 cubic yards face-stone delivered on United States barges in canal, or in the river within 5 miles of the head of canal, or 1 mile of its foot.		290 cubic yards backing-stone delivered on United States barges in canal, or in the river within 5 miles of the head of canal, or 1 mile of its foot.		5,000 cubic yard riprap face-stone delivered on United States barges in canal, or in the river within 5 miles of the head of canal, or 1 mile of its foot.		2,500 cubic yards rubble filling delivered on United States barges in canal, or in the river within 5 miles of the head of canal, or 1 mile of its foot.		Aggregate.
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.	
1	J. A. Green, Stone City, Iowa	$11 75	$2,056 25	$9 50	$2,755	$7 50	$37,500	$7 50	$18,750	$61,061 25
2	J. Mantz	10 00	1,750 00	5 50	1,595	2 25	11,250	65	1,625	16,220 00
3	E. G. Kemper, Burlington	11 50	2,012 50	5 50	1,595	2 20	11,000	70	1,750	16,357 50
4	J. H. Cole, Keokuk	9 00	1,575 00	6 00	1,740	3 00	15,000	75	1,875	20,190 00
5	Curtis & Diver	11 00	1,925 00	6 00	1,740	2 75	13,750	60	1,500	18,915 00
6	W. Patrick, Phœnix, N. Y	9 00	1,575 00	6 00	1,740	4 00	20,000	3 00	7,500	30,815 00
7	Patterson Bros., Keokuk	9 00	1,575 00	5 00	1,450	2 00	10,000	50	1,250	14,275 00

REPORT OF MR. M. MEIGS, UNITED STATES CIVIL ENGINEER.

KEOKUK, IOWA, *July* 1, 1885.

MAJOR: I have the honor to submit the following report of work done on improving Des Moines Rapids, Mississippi River, for the fiscal year ending June 30, 1885:

RIPRAPPING CANAL EMBANKMENT.

The inside face of the canal embankment in the upper level has been since 1878 covered with slope wall to a height of about 2 feet above the general level of water in the canal, and in the lower level since 1883 to a height of 2 feet above the level of high water of 1881.

The original plan contemplated covering the part of the slope above the riprap face wall with loose stone, and this work is now in progress. A large portion of the outside slope from the middle lock down is now protected by a regular and substantial covering of slope wall carefully laid, and this work will be completed during the coming season. The stone has been delivered on United States barges, at their quarry, by Patterson Brothers, under contracts dated September 8, 1884, and March 24, 1885, and towed to the work by the canal launch. The laying has been done by day's labor. During the last fiscal year 2,333.84 cubic yards riprap face stone has been received and laid, and 4,608.37 riprap stone have been placed on embankment.

RAISING LOWER LOCK WALLS.

Work on the west wing-wall at foot of canal was continued and completed June 20, 1885. These wing-walls are now 4 feet higher than the lock-walls, which latter will eventually be raised to the same height.

The improvement of the entrance to the canal due to raising wing-walls is very marked; boats have now no difficulty in safely entering the locks from below, and the columns and lock machinery are no longer endangered as was formerly the case. There has been used in the raising of these two wing-walls 354.70 cubic yards face and 393 cubic yards of backing stone. There have also been used 965 cubic yards of earth-filling, mostly taken from the quarry just above the lower lock.

DREDGING ROCK FROM THE CANAL BETWEEN NASHVILLE AND MONTROSE, IOWA.

The United States canal-dredge worked steadily from August 21 to November 19, on this work. From July 13 to August 31, Assistant Engineer J. C. McElherne made an examination of the channel from Nashville to Montrose. A small barge was used with a railroad rail suspended by ropes from each end, at a height of 6 inches above the bottom of the excavated channel.

By means of the canal-launch Stella, this sweep was allowed to drift over every part of the channel, and every projection which caught the rail was located by a buoy thrown from the boat. These buoys were located by two theodolites stationed on the shore, and the patches of rock were subsequently removed by the canal-dredge between August 1 and November 19.

In some cases the original survey probably omitted patches, and in others there were large stones left which escaped former dredging operations. In one case quite a large patch of level rock, 18 inches above grade, was broken up and made suitable for dredging by exploding powerful charges of dynamite on the surface of the rock. A diver was employed a good part of the time to chain such rocks as the dredge-dipper could not accommodate.

I send herewith a map of the channel, showing that a few patches of rock still remain slightly above the proposed grade of canal bottom. Nearly, if not all, of these patches are so little above (one to eight-tenths of a foot) grade that their present removal is not a matter of any importance to navigation. I should recommend, therefore, the use of any money in hand or received by appropriation of Congress in the immediate future to the work of completing or securing the canal walls and perfecting the entrance, rather than to the removal of these patches.

There is still a small amount of rock blasted, but not dredged, which should be removed the present season, and is not included in the above remarks.

STATEMENT OF ROCK REMOVED.

	Cubic yards.
August, 1884	71
September, 1884	392
October, 1884	1,091
November, 1884	260
Total	1,814

The cost of this dredging was above the average of such work by the canal-dredge, but the work was so scattered and difficult that it was necessarily expensive.

REPAIRS TO BARGES AND PLANT.

The drill-boat was hauled upon the boat and condemned, after ineffectual attempts to keep her afloat. The hull is no longer serviceable. Several barges also went out of service, having been eleven years on the work. The expense of repairing the dredge was borne mostly by the appropriation for operating and care of canal.

SLUICES AT LAMALLEE'S AND PRICE'S CREEKS.

The amount expended for dredging mud from the canal proper during the past eight years is, approximately, $80,000.

This dredging has removed the heavier portions of the deposit brought in by the creeks and dropped near their mouths. The lighter portions, in a finely-diffused state, are borne to long distances, and are gradually raising the bottom of the canal over its whole length. An estimate for building sluices opposite the mouths of two of the worst creeks, amounting to $15,500 and $18,000, respectively, was submitted with your last annual report. These sluices would remove at once on its entrance to the canal the finely-diffused mud, as well as a great part of the heavy deposit, and by localizing the whole cheapens the removal of the balance by dredges. Your attention is again invited to this subject.

Summary of work accomplished during the past year improving Des Moines Rapids.

Designation.	Price.	Cubic yards received.	Cubic yards laid.
Face stone	$9 00	168.20	168.20
Backing stone	5 00	68.67	68.67
Riprap face stone	2 00	2,333.84	2,333.84
Rubble filling	50	2,500.00	2,500.00
Riprap stone	48¼	542.24	542.24
Do	61	1,566.13	1.566.13

	Cubic yards.
Rock dredged	1,814
Square yards slope-wall stone laid	4,664
Square yards slope covered with rubble stone	8,874

EXTENDING LOWER END OF CANAL WALL TO BRIDGE.

The act of July 5, 1884, allotted $10,000 of the $50,000 appropriated for improving Des Moines Rapids to building a crib to connect the lower end of the canal with the pier of the Keokuk and Hannibal Bridge.

Inasmuch as the estimate for this crib is $50,000, it has not been considered advisable to begin the work until enough money is in hand to insure its completion. The ice would seriously endanger it in an unfinished state.

I have been assisted at various times by overseers J. C. McElherne, S. Edwards, and John R. Carpenter, and by clerk O. S. Willey. All these gentlemen performed their various duties with diligence and intelligence.

Very respectfully,

M. MEIGS,
United States Civil Engineer.

Z 10.

OPERATING AND CARE OF DES MOINES RAPIDS CANAL.

The canal was open for navigation during the past year 214 days, being closed by ice 151 days. A favorable stage of water permitted frequent use of the channel over the rapids.

There were passed through the canal during the year 889 steamboats and 169 barges, carrying 13,065 passengers, 54,120 tons of merchandise, and 776,432 bushels of grain; also 43,119,797 feet of lumber, 2,779,670 feet of logs, 25,018,750 shingles, and 13,473,205 lath.

Repairing canal embankments and removing deposits washed in from the bluffs have as heretofore been a continual source of trouble and expense. Forty-four thousand one hundred and three cubic yards of material were removed from canal and from channel below Montrose.

Four new dump-boats, built for use in connection with the canal-dredge, were received from the contractor in October, 1884. Numerous repairs to boat and machinery were made during the year at the canal shops.

The expenses of operating and care of the canal are now provided for by an indefinite appropriation made by act of March 3, 1881. The original estimate of annual expenditures was $40,000. With a completed canal, and without any extraordinary expenses, this sum would be sufficient, and would permit the accumulation of a fund to provide for renewing gates and other perishable appendages.

The estimate for expenses of the past year, including dredging open channel between Nashville and Montrose, was $45,000. There was expended during the year, exclusive of outstanding liabilities July 1, 1884, the sum of $38,704.50.

The estimate submitted for the coming year, including dredging as above, is $43,000, and it is expected a greater saving will be effected in the present year than the last.

The electric light at the lower lock has proved most satisfactory, and the system of lighting should be extended as rapidly as circumstances permit.

Section 7 of the river and harbor act of July 5, 1884, authorized the Secretary of War to prescribe such rules and regulations as are required by public necessity.

The following regulations were submitted March 18, 1885, and approved by the Secretary of War under date of April 14:

(1) *Penalties.*—The river and harbor act approved July 5, 1884, contains the following section: "Section 7. That it shall be the duty of the Secretary of War to prescribe such rules and regulations in respect to the use and administration of the Des Moines Rapids Canal, the Saint Mary's Falls Canal, and the Louisville and Portland Canal as in his judgment the public necessity may require, which rules and regulations shall be posted in some conspicuous place for the information of the public. Any person knowingly and willfully violating such rules and regulations shall be liable to fine not exceeding five hundred dollars, or imprisonment not exceeding six months, to be enforced in any district court in the United States within whose territorial jurisdiction such offense may have been committed."

(2) *Authority of canal officers.*—The movement of all boats and floating things in the canal, the locks, and the approaches to the canal, shall be under the direction of the canal officers.

(3) *Signals.*—All boats approaching the locks shall signal for the same by four distinct whistles of short duration, and shall not pass the point indicated by a sign-board until the lock signal is given. The lock signals will be: For entering, one whistle; for passing out, three short whistles. At night a red light, changing to green, will be the signal for entering.

(4) *Entrance to locks.*—When two or more boats or tows are waiting to enter the canal or any of the locks, the lock-master shall have authority to designate the time and order of their entrance, and no boats or tows shall enter without his authority.

When more than one boat is waiting to enter a lock, the masters must ascertain from the lock-master when their turn will come.

Boats wishing to pass a lock shall not approach nearer than a fixed point—which will be marked by a sign-board on the canal bank—until the signal is given to enter the lock, and they shall take position in rear of any boats, tows, or rafts that may precede them, and not in any way obstruct the channel.

(5) *Precedence at locks.*—Ordinarily boats and tows arriving first at the locks shall have the precedence in passing, but in all cases boats and barges belonging to the United States or employed upon public work shall have precedence over all others, and passenger boats shall have the precedence over tows. Rafts shall have one lock-

age in their turn, except where there are two or more rafts together at a lock, in which case no part of a raft shall pass the lock until the whole of the raft or rafts preceding it shall have passed.

All boats, &c., arriving at the locks and not taking advantage of the first lawful opportunity to pass shall lose the turn.

(6) *Moorings in locks.*—All boats when in the locks shall fasten one head-line and one spring-line to the snubbing-posts on the lock-walls. Large boats shall use one head-line and two spring-lines, and the lines shall not be unloosed until the signal is given for the boat to leave the lock.

(7) *Delays in canal.*—No boat, barge, raft, or other floating craft shall tie up in, or in any way obstruct, the canal or its approaches or delay entering or leaving the locks, except by permission from proper authority. Boats wishing to tie up for some hours or days in the canal must notify the officer in charge, through the lock-master, and proper orders in the case will be given. Boats so using the canal must be securely moored in the places assigned them, and if not removed promptly on due notice will be removed at the owner's expense by the canal officers.

All rafts or tows passing the locks in sections shall "make up" just below or above the lock on the shore side.

(8) *Injury to locks and fixtures.*—Boats shall use great care not to strike any part of the lock or sluice walls, or any gate or appurtenance thereto, or machinery for operating the gates, or the walls protecting the banks of the canal.

All boats using the canal shall be free from projecting irons or rough surfaces that would be liable to damage the locks or any part of the canal, and they shall be provided with fenders to be used in guarding the lock-walls, &c., from injury.

(9) *Handling gates.*—No one, unless authorized by the lock-master, shall open or close any gate or wicket, or in any way interfere with the employés in the discharge of their duties. But the lock-master may call for assistance from the master of any boat using the lock, should such aid be needed.

(10) *Draught of boats.*—No boat shall enter the canal or locks whose actual draught exceeds the least depth of water in the channel of the canal as given by lock-master.

(11) *Meeting and passing.*—Meeting boats shall keep to starboard. Rafts must give to steamers the side demanded by a proper signal. Boats must not race or crowd alongside of each other while under way in the canal.

(12) *Boats and rafts without steam.*—No raft or boat shall be brought through the canal unless accompanied by a steamboat, except small boats controlled by sails or oars; and small boats used for private purposes shall not pass the locks except by permission.

(13) *Refuse in canal.*—No person shall throw stone or material of any kind into the canal or locks, and boats passing through shall not deposit the ashes or cinders from their furnaces in the canal or locks.

(14) *Trespass.*—No one shall trespass upon the canal property, or in any way injure the canal, the locks, or any of the appendages.

(15) *Commercial statistics.*—Masters or clerks of boats shall furnish, in writing, to the lock-master at the lower lock of the canal, such statistics of passengers and cargo as may be required.

Detailed information as to work accomplished is given in the appended report of Mr. M. Meigs, United States civil engineer.

Money statement.

July 1, 1884, amount available on approved project for fiscal year ending June 30. 1885	$45,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	38,704 50
July 1, 1885, outstanding liabilities	60 82

Detailed statement of expenditures for operating and maintaining Des Moines Rapids Canal for fiscal year ending June 30, 1885.

OFFICE AND GENERAL ADMINISTRATION.

Date.	Salaries.	Supplies.	Miscellaneous.	Total.
1884.				
July	....	$25 68	$31 35	$57 03
August	$435 00	....	55 22	490 22
September	....	109 04	116 00	225 04
October	435 00	....	4 25	439 25
November	435 00	3 95	....	438 95
December	735 00	....	92 50	827 50
1885.				
January	435 00	1 05	....	436 05
February	435 00	25 65	21 12	481 77
March	435 00	....	155 42	590 42
April	770 00	35 79	....	805 79
May	435 00	17 14	32 52	484 66
June	465 00	27 01	65 50	557 51
Total	5,015 00	245 31	573 88	5,834 19

CANALS AND LOCKS.

Date.	Labor.	Supplies.	Current repairs.	Total.
1884.				
July	$1,545 67	$92 37	$92 11	$1,730 15
August	1,583 16	766 90	105 35	2,455 41
September	1,562 84	297 68	236 28	2,096 80
October	1,587 66	120 60	304 02	2,012 28
November	1,444 98	97 37	853 65	2,396 00
December	1,486 00	98 96	875 09	2,460 05
1885.				
January	1,405 00	....	118 19	1,523 19
February	1,410 00	110 23	176 67	1,696 90
March	1,460 00	20 57	481 00	1,961 57
April	1,414 16	145 66	697 27	2,257 09
May	1,284 00	208 24	540 01	2,032 25
June	1,432 50	37 34	758 24	2,228 08
Total	17,615 97	1,995 92	5,237 88	24,849 77

DREDGING CANAL.

1884.				
July	$1,614 67	$319 61	$50 43	$1,984 71
August	961 17	1,247 03	475 24	2,683 44
September	215 00	541 07	161 15	917 22
October	....	....	595 82	595 82
November	....	....	....	....
December	....	....	213 39	213 39
1885.				
January	....	....	33 30	33 30
February	....	....	30 26	30 26
March	....	....	122 00	122 00
April	....	99 31	76 53	175 84
May	....	....	....	....
June	562, 28	571 67	130 61	1,264 56
Total	3,353 12	2,778 69	1,888 73	8,020 54

SUMMARY.

Date.	Grand total.	Date.	Grand total.
1884.		1885.	
July	$3,771 89	January	$1,992 54
August	5,629 07	February	2,208 93
September	3,239 06	March	2,673 99
October	3,047 35	April	3,238 72
November	2,834 95	May	2,516 91
December	3,500 94	June	4,050 15
		Total	38,704 50

REPORT OF MR. M. MEIGS, UNITED STATES CIVIL ENGINEER.

UNITED STATES ENGINEER OFFICE,
Keokuk, Iowa, July 1, 1885.

MAJOR: I have the honor to submit the following report for operating and care of Des Moines Rapids Canal for the fiscal year ending June 30, 1885.

It was open to navigation two hundred and fourteen days and closed one hundred and fifty-one days during the year. There was a season of high water during the spring, accompanied by very heavy ice. Some damage was done to the slopes of canal embankment.

The highest water during fiscal year was 15.1 feet, January 9, 1885. The lowest water was 2.5 feet, December 4, 1884; both referred to low water of 1864. The lower lock-gates were open six days, and guard-locks from 20th July to 27th of August, thirty-eight days.

The electric-light plant at lower lock has proved itself of great use to boats passing through the canal and in facilitating repairs at the lock when made of necessity in the night time.

REFITTING AND REPAIRING CANAL EMBANKMENT.

It was thought last season that the repairs on canal embankment would this year be insignificant, but the damage due to ice and high water and the increasing leaks in the Sections 25 and 26 at the dry-dock have required a great deal of work to keep it in order. In the latter part of November, 1884, after closing the canal, about 500 feet of the embankment was removed down as low as 2 feet below the level of dry-dock bottom and 5 feet below the original bottom of the bank. The earth was then filled in again, rammed and puddled, and nearly all of the leaks in that section were stopped.

The expense of this work alone was $1,061.56. In Sections 18, 19, 20 the ice carried away the toe of riprap, on which the slope wall starts, besides damaging the wall itself. This rock had to be replaced at a considerable expense for stone and labor; 1,253 cubic yards of stone were used in this work.

DREDGING THE CANAL.

The canal dredge worked a good part of the season removing deposits from various portions of the canal. United States tow-boat No. 3 (Vixen) and dredge No. 2 were also employed from June 30 to July 26 removing deposit from the canal at Sandusky, and from July 27 to August 4 in the open canal at Montrose, where a large accumulation of sand interfered with navigation.

The season's work in this canal for both dredges is as follows:

		Cubic yards.
Dredge No. 1, mouth Price's Creek	4,463	
Dredge No. 1, below lower lock	11,888	
Dredge No. 1, below middle lock	7,430	
Dredgo No. 1, above guard lock	2,045	
Total		25,826
Dredge No. 2, at Sandusky	12,270	
Dredge No. 2, at Montrose Drain	6,007	
Total		18,277
Making a grand total of		44,103

The canal dredge was used at Fort Madison from November 5 to November 10, 1884, and from April 21 to June 9, 1885. She worked on removing rock from the Des Moines Rapids from August 17 to November 19, 1884, exclusive of the five days she was at work at Fort Madison.

The dredging at Montrose was provided for by an addition to the ordinary allotment for the operating and care of the Des Moines Rapids Canal. Four new dump-boats 73 feet 4 inches long, 18-foot beam, 8 pockets each, were delivered by the contractor October 8, 1884, at Le Claire, Iowa. These boats were completed at the canal shops, where the chain rigging was made and put on. They have proved very substantial and good boats. Their capacity in light material is between 80 and 90 cubic yards of mud. The following shows the amount of material removed from the canal proper from the opening to the present time:

Table showing amount of material removed from the Des Moines Rapids Canal proper from June 30, 1878, to June 30, 1885, material dredged from Montrose Cut not included.

Period.	United States dredges.	Teams.	Contract.	Total.
Fiscal year ending June 30, 1879	8,700	....	....	8,700
Fiscal year ending June 30, 1880	26,496	1,288	11,558	39,337
Fiscal year ending June 30, 1881	9,003	....	....	9,003
Fiscal year ending June 30, 1882	18,031	....	49,758	67,789
Fiscal year ending June 30, 1883	22,717	....	90,858	113,575
Fiscal year ending June 30, 1884	52,616	....	....	52,616
Fiscal year ending June 30, 1885	38,097	....	....	38,097
Grand totals	175,660	1,288	152,169	329,117

In addition to the above, there have been removed from the head of the channel at Montrose by the two United States dredges:

	Cubic yards.
Fiscal year ending June 30, 1883	16,643
Fiscal year ending June 30, 1884	25,315
Fiscal year ending June 30, 1885	6,007
	47,965

By reference to the above figures, it will be seen that 329,117 cubic yards of mud and sand have been removed from the canal at various times and places during the first seven years of its operation; making a low estimate of the cost of this dredging, at 25 cents per cubic yard—a figure much less than we have been able to contract it for—the total value of this dredging is, in round numbers, $80,000.

The annual report for 1884 contained an estimate for $33,500 to build two sluices, with gates opposite the two creeks, bringing most of the deposit into the canal. These sluices would be an economy, as they would obviate to a great degree the necessity for dredging. Probably one-half of all the sediment could be sluiced direct into the river.

REPAIRS TO FLAT-BOATS, DREDGE, ETC.

The usual current repairs have been made to boats and barges belonging to the canal and to the various other appropriations. Dredge No. 1 had a few repairs made to her engines and other machinery. Tow-boat Vixen was hauled out on the ways and calked, and a large number of barges repaired and calked from time to time. The expense of these repairs was born by the appropriations to which the boat or barge pertained. Three steam-launches were also built at the lower lock and have given good satisfaction.

REPAIRS TO LOCK MACHINERY.

At the guard-lock an iron spar, worked by the same hydraulic system of ropes that formerly operated the gate, was made and fitted to the east guard-gate. The inner end of this spar rests on a small iron truck, which runs in and out on a track curved so as to bring the face of the spar tangent to all points of its travel to a double sheave, mounted on the lock wall; two wire ropes, run one from each end of the spar, and, passing around the sheaves in opposite directions, are carried to and connected with the hydraulic cylinder, which was already in place.

The spar works admirably, and entirely does away with the trouble from drift lodging on the chains, which, in the original mode of operating by chains under the gates, caused at this lock endless trouble and expense. The system works well, however, at the other locks. The hand-spar that has been in operation for a year past has been removed, and the gate is reported as working better than it ever did.

Repairs were made on the middle lock pumps, the distributing valve at lower lock, and to many other parts of the machinery wherever needed.

MACHINE SHOP AT LOWER LOCK.

During the winter months the four lock engineers and two carpenters belonging to the lock force have been kept steadily at work overhauling and repairing machinery belonging to the various boats, &c., of the United States, laid up in the canal, and the lock machinery.

The convenience and economy of such a shop has been abundantly demonstrated during the last year.

OFFICE BUILDING.

I would again call your attention to the need of a proper office for the canal superintendent's use and the storing of valuable records. The office of the canal up town necessitates running to and fro, and it is very inconvenient in every way. Necessarily much of the Superintendent's time is at present occupied with the supervising of repairs to plants and machinery, a great portion of which is executed at the lower lock.

The drawings and records should be close at hand for reference and use.

Three thousand dollars is estimated for the construction of a suitable small building. The rent of the present office ($240 per year) amounts, capitalized, to $6,000.

BUSINESS OF THE CANAL.

There was a good stage of water nearly all through the year. As a consequence a great part of the commerce went outside of the canal and does not show on the traffic statement.

EXPENSE OF OPERATING CANAL.

The project submitted for past fiscal year and approved was as follows:

Services of operating force	$18,000
Fuel, locks and machine shop	900
Lights	300
General supplies	1,000
Repairs to buildings, machinery, and plant	3,000
Repairs to canal embankment	2,000
Dredging in canal	9,800
Contingencies, superintendence, office expenses, &c	5,000
Dredging open canal between Nashville and Montrose	5,000
Total	45,000

There has been expended for operating and care, exclusive of outstanding liabilities reported July 1, 1884, the sum of $38,704.50, being $6,295.50 less than the estimate made at beginning of year. A large part of this saving was from the dredging required at Montrose proving less than was anticipated. The items for dredging the canal proper will constantly be increasing from year to year if the canal is to be kept in good condition. The lighter portions of the sediment brought in the canal are gradually filling it along its whole length. This deposit is not yet sufficient to interfere with navigation, but will finally, unless steps are taken to get rid of the mud as it enters from the creeks, necessitates a grand dredging, extending over some 5 miles in extent. The dredging heretofore has been pretty generally limited to the heavier deposits in the vicinity of the three creeks, the feeder at the upper end of the canal, and the lower entrance. Much of the light deposit, if not all, can be turned into the river by suitable sluices during the flood season without its spreading through the canal at all. The construction of these sluices has been referred to under the head of "Dredging in the canal." In the work connected with operating and care of the canal, I have been assisted by Mr. S. Edwards, Mr. W. A. Thompson, and Clerk O. S. Willey. To these and the members of the operating force in general I am indebted for faithful and efficient service.

Tables A and B are appended.

Very respectfully,

M. MEIGS,
United States Civil Engineer.

Maj. A. MACKENZIE,
Corps of Engineers, U. S. A.

SCHEDULE A.—*Traffic statement of the Des Moines Rapids Canal for the fiscal year ending June 30, 1885.*

Months.	Steamboats.	Barges.	Passengers.	Merchandise.	Grain.	Lumber.	Logs.	Shingles.	Lath.	Lockages at one lock.
				Tons.	*Bushels.*	*Feet.*	*Feet.*	*Number.*	*Numbers.*	
July	221	12	2, 953	5, 649	69, 653	7, 849, 232	799, 670	3, 499, 500	1, 748, 900	851
August	189	19	4, 457	6, 364	47, 704	21, 902, 187	1, 500, 000	11, 650, 250	6, 345, 330	270
September	138	23	1, 535	5, 581	46, 725	13, 368, 378	480, 000	9, 269, 000	5, 378, 975	206
October	66	7	893	3, 432	23, 300	....	....	....	....	98
November	37	24	416	7, 408	170, 642	....	....	....	....	54
April	33	23	236	6, 384	102, 745	....	....	....	....	72
May	96	42	787	8, 423	225, 857	....	....	600, 000	....	67
June	109	19	1, 788	10, 879	89, 806	....	....	....	....	152
	889	169	13, 065	54, 120	776, 432	43, 119, 797	2, 779, 670	25, 018, 750	13, 473, 205	1, 270

SCHEDULE B.—*Comparative traffic statement showing the total traffic that has passed through the canal since its opening in 1877 by fiscal year ending June 30.*

Fiscal year.	Steamboats.	Barges.	Passengers.	Merchandise.	Grain.	Logs.	Lumber.	Lath.	Shingles.	Lockages at one lock.
				Tons.	*Bushels.*	*Feet.*	*Feet.*	*Numbers.*	*Number.*	
1878	670	548	....	53, 346	737, 415	....	25, 000, 000	4, 000, 000	3, 700, 000	824
1879	802	454	5, 008	64, 658	2, 192, 642	8, 086, 000	33, 347, 612	8, 721, 796	11, 749, 500	1, 564
1880	967	651	13, 231	78, 989	2, 197, 469	13, 160, 960	21, 832, 478	27, 863, 640	30, 561, 150	2, 497
1881	840	276	10, 003	44, 962	1, 154, 092	11, 013, 410	52, 256, 235	11, 657, 655	15, 091, 000	1, 339
1882	760	444	8, 588	29, 043	781, 817	4, 475, 000	17, 150, 011	3, 112, 825	4, 885, 250	2, 292
1883	1, 107	705	9, 192	43, 359	729, 174	1, 040, 000	13, 093, 325	11, 558, 000	4, 435, 000	1, 353
1884	913	245	13, 057	54, 215	470, 580	9, 399, 764	57, 018, 151	15, 924, 645	25, 182, 250	1, 908
1885	889	169	13, 065	54, 120	776, 432	2, 779, 670	43, 119, 797	13, 473, 205	25, 018, 750	1, 270
	6, 948	3, 492	72, 144	422, 692	49, 954, 804	49, 954, 804	262, 817, 609	96, 311, 766	120, 622, 900	13, 047

Z II.

DRY-DOCK AT DES MOINES RAPIDS CANAL, MISSISSIPPI RIVER.

The history of this work up to June 30, 1884, is given in my last annual report. During the past year the embankment has been completed, the earth has been removed from the prism of the dock and placed in embankment at its lower end, and the construction of the sluice-ways has been commenced. The details of this work are given in the appended report of Mr. M. Meigs, United States Civil Engineer.

There is required to complete this work, according to original project, $65,000. This amount can be used to good advantage in one season. If the work is prolonged over a longer time it is probable the cost will be increased. The plant belonging to the United States and used in connection with the improvement of the Mississippi River, and the entire commerce of the upper river are liable to be benefited by this improvement.

ABSTRACT OF APPROPRIATIONS.

By act passed August 2, 1882	$30, 000
By act approved July 5, 1884	30, 000

Money statement.

July 1, 1884, amount available		$2,023 50
Amount appropriated by act approved July 5, 1884		30,000 00
		32,023 50
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$23,227 90	
July 1, 1885, outstanding liabilities	239 82	
		23,467 78
July 1, 1885, amount available		8,555 72
Amount (estimated) required for completion of existing project		65,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		65,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of all proposals received and opened this 5th day of September, 1884, *at 2 p. m., by Maj. A. Mackenzie, Corps of Engineers, for furnishing stone for construction of dry-dock at the Des Moines Rapids Canal.*

No.	Names and residences of bidders.	Face stone 300 cubic yards delivered on United States barges in canal or in the river within 5 miles of the head of the canal or 1 mile of its foot.		Backing stone 600 cubic yards delivered on United States barges in canal or in the river within 5 miles of the head of the canal or 1 mile of its foot.		Aggregate.
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	
1	J. A. Green, Stone City	$11 75	$3,525	$9 50	$5,700	$9,225
2	Patterson Brothers, Keokuk	8 00	2,400	5 00	3,000	5,400
3	J. S. Roper, Grafton	12 00	3,600	6 50	3,900	7,500
4	J. Mantz, Keokuk	10 00	3,000	5 50	3,300	6,300
5	E. G. Kemper, Burlington	11 50	3,450	5 50	3,300	6,750
6	J. H. Cole, Keokuk	11 00	3,300	6 00	3,600	6,900
7	Curtis & Piver, Keokuk	11 00	3,300	6 00	3,600	6,900
8	C. L. Williams, Keokuk	12 50	3,750	6 50	3,900	7,650
9	William Patrick, Phœnix, N. Y	9 00	2,700	6 00	3,600	6,300

REPORT OF MR. M. MEIGS, UNITED STATES CIVIL ENGINEER.

UNITED STATES ENGINEER OFFICE,
Keokuk, Iowa, July 1, 1885.

MAJOR: I have the honor to make the following report of work done on the dry-dock at the Des Moines Rapids Canal, Mississippi River, for the fiscal year ending June 30, 1885.

This work was begun in the fiscal year ending June 30, 1883. At the close of the fiscal year ending June 30, 1884, the outside embankment was partially completed. Three thousand cubic yards of riprap face stone had been delivered, and was partially distributed along the slopes.

During the fiscal year ending June 30, 1885, the embankment has been completed, and the greater portion of the earth removed from the prism of the dry-dock and used to form the platform at the lower end of the dock.

The cutting and laying of stone for the dry-dock sluice is now in progress. It was found expensive and troublesome to get a good foundation for the sluice walls.

The 12-inch pump and engine belonging to the appropriation for improving Des Moines Rapids were used for the drainage of the dock-prism, and at times was taxed to the utmost in removing the large amount of water coming through the old canal embankment. Most of this leakage is now carried by a flume direct to the river, and the pump easily keeps the smaller leaks down.

Two courses of stone have been laid in the side and breast walls of the sluice, and a large amount of stone is cut and ready for laying. The slope-wall stone on hand has been largely laid on the slope of the embankment. A portion of this stone that was laid rather prematurely, owing to the fear of injury to the bank by ice, has settled so that it will have to be taken up and reset. The experience of the two last winters shows, however, that the laying of this stone was necessary for the safety of the work, as the heavy ice in the spring freshets runs with great force against the dry-dock embankment.

The iron gates and frames for the sluices, four in number, and for the pump-well, are completed. and ready to be put in place as soon as the masonry is prepared to receive them. It is hoped that the present appropriation will complete the sluice and gates so that the rest of the work can henceforth proceed without reference to the stage of water in the river.

The following statement shows the work accomplished during the past fiscal year:

Material.	Received.	Laid.
	Cubic yards.	*Cubic yards.*
Face stone	235.91	
Backing	102.19	
Riprap stone	762.88	762.88
Slope wall		854.45

Earth removed from Dry Dock Prism, about 11,000 cubic yards.

Clay taken from borrow pit, transferred across the canal, and put in embankment, 8,048 cubic yards.

A large part of the expense during the past year has been incurred in excavating earth and rock for foundation for masonry, building and erecting derricks, putting up pumping-engine, &c., which are good for all the work to follow in completing the dry-dock.

During the fiscal year work has been carried on between July 28 and November 19, 1884, and from April 1 to June 30, 1885.

In the above work I have been assisted by Mr. O. S. Willey, draughtsman, who made the drawings for the masonry work, Mr. John R. Carpenter and Mr. S. Edwards, overseers. My thanks are due these gentlemen for efficient and cheerful assistance in carrying on the work.

Very respectfully, your obedient servant,

M. MEIGS,
United States Civil Engineer.

Maj. A. MACKENZIE,
Corps of Engineers, U. S. A.

Z 12.

IMPROVEMENT OF QUINCY BAY, ILLINOIS.

There was no money available for work under this head of appropriation during the past fiscal year, but the river and harbor act of July 5, 1884, provided, under head of "Improving Mississippi River from Des Moines Rapids to the mouth of the Illinois River," for continuing work in Quincy Bay and an allotment of $12,500 for continuing dredging as directed by Congress was made from the general appropriation. The work was advertised and contract made with the lowest bidder, Mr. H. S. Brown, of Quincy. On September 1, 1884, before operations were begun, the work was transferred to Capt. E. H. Ruffner, Corps of Engineers.

ABSTRACT OF APPROPRIATIONS.

By act approved March 3, 1881	$10,000
By act approved August 2, 1882	15,000
By act approved July 5, 1884, allotment from "Improving Mississippi River, Des Moines Rapids to mouth of Illinois River"	12,500

NOTE.—Twenty thousand dollars additional alloted from appropriation for "Improving navigation of Mississippi River at Quincy, Illinois," has been used in the improvement.

Z 13.

REMOVING OBSTRUCTIONS IN MISSISSIPPI RIVER.

No appropriation having been made in river and harbor act of July 5, 1884, under title of "Improving Upper Mississippi River, operation of snag-boats," an allotment of $15,000 from above appropriation was made for continuing snagging work north of the mouth of the Missouri, but it appearing subsequently that this allotment would seriously interfere with projected work on the Lower Mississippi and it being practicable in the emergency to provide for the Upper Mississippi by allotments from the general appropriations, the greater portion of the amount was transferred to Maj. C. R. Suter, Corps of Engineers.

The amount expended was $2,049.37.

Money statement.

Allotment from appropriation of July 5, 1884	$15,000 00
July 1, 1885, amount expended during fiscal year	2,049 37
Amount transferred to Maj. C. R. Suter	12,950 63

Z 14.

PRELIMINARY EXAMINATION OF SNY ISLAND LEVEE, ON THE MISSISSIPPI RIVER.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., September 9, 1884.

GENERAL: In reply to your letter of July 31, 1884, requesting estimates of the amount of funds required for certain preliminary examinations provided for by the river and harbor act of July 5, 1884, I have the honor to report as follows regarding—

> Sny Island Levee, on the Mississippi River, and the Secretary of War shall report what benefit, if any, this levee has been to the improvement of the channel and navigation of the river, and he shall submit an estimate of the probable cost of strengthening and preserving said levee so as to insure and maintain that benefit.

Having already given some consideration to this subject, and having, in my opinion, sufficient data on hand, I do not believe any preliminary examination is needed for determining the general relation of the Sny Levee to the interests of navigation.

Under date of August 24, 1882, a letter was addressed to the president of the Mississippi River Commission by Mr. Clark, of Hannibal, Mo., in which the claim was made that the construction of the Sny Levee had greatly benefited navigation of the Mississippi River between Quincy and Hannibal. In my report on this letter, addressed to the Chief of Engineers under date of May 14 (or 17), 1883, I gave fully my views, which did not agree with those expressed by Mr. Clark. A copy of this report is transmitted herewith.

The Sny Levee is about 50 miles long, and a thorough examination of the embankment, the channel and bed of the river adjacent, and the low grounds on both sides of the river, and the taking of proper discharge and other observations, would be a very lengthy and expensive operation. As regards the condition of the bed of the river since the levee was constructed, I would say that a complete survey of the river-bed was made in 1878, and numerous surveys at special localities within the limits of the levee have been made since that date.

But neither the surveys already made nor a new survey, such as is referred to above, would furnish the means of comparing the conditions before and after levee construction, unless earlier maps than those in the possession of the Government can be obtained. Mr. Corthell, formerly chief engineer of the Sny Island Levee, in a letter addressed to General Logan, under date of November 19, 1883 (see page 21, report select Senate committee, Report No. 36, Senate, Forty-eighth Congress, first session), reports that complete surveys of the river were made while the levee was in course of construction. If copies of such maps can be secured I have no doubt I can without further survey make a direct comparison of the condition of the river within the limits of the levee before and after levee construction. Without such a direct comparison a consideration of the general effect of the Sny Levee on the interests of navigation must be purely theoretical, for the opinions and recollections of navigators on this subject are so different that such evidence is unreliable.

In the absence of any direct evidence that the Sny Island Levee has benefited navigation, as has been claimed by Mr. Clark and others, I have formed and expressed the opinion that, while the closing of the Sny Slough, and other side channels, has not played the very important part assigned it, some benefit has resulted from the construction of the levee, the value of such benefit being the cost of such work as the Government would have undertaken for closing these side sloughs. So far as such work is concerned there is a claim against the Government which is worthy of consideration, and it would seem proper that the facts and estimates should be laid before Congress for its action.

I would, therefore, suggest a survey sufficient in detail to enable me to determine to what extent side sloughs have been closed, the condition of the levee closing such sloughs, and the probable cost to the United States of works which would be built in the interests of navigation if such levee did not exist. I would also propose corresponding with Mr. Clark, of Hannibal, and, if necessary, with others regarding the old surveys and maps referred to by Mr. Corthell. This survey and the preparation of a report and estimates will cost approximately $500.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MAJOR A. MACKENZIE, CORPS OF ENGINEERS, OF MAY 14, 1883.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., May 14, 1883.

GENERAL: As instructed by your letter of April 30, 1883, I have the honor to submit the following report on a letter addressed August 24, 1882, to General Q. A. Gillmore, president Mississippi River Commission, by Mr. C. N. Clark, of Hannibal, relating to the influence of the Sny Levee upon the navigation of the Mississippi River.

It is claimed by Mr. Clark that the closing of the Sny Carte Slough by a levee caused in 1872 the complete removal of a bar which up to that date had been the most serious obstruction to navigation between Saint Louis and Keokuk, and that in general the Sny Levee has greatly improved navigation. For these reasons Mr. Clark further argues that the United States should assume certain work in connection with the maintenance of the Sny Levee.

For all information as to bars and changes in the Mississippi River previous to the year 1878, the date at which the Government made a detailed survey of the Mississippi River, dependence must be placed on the memory of those who were practically engaged in navigation.

I have consulted a number of the best-informed river men, and from information gained I am obliged to differ in opinion from Mr. Clark. It appears that the bar referred to in Mr. Clark's letter as "Gun Lock," known also as "Armstrong's," "McDonald's," and "Lower Whitney's," was in former years, at times, troublesome, but no more so than several other points between Saint Louis and Keokuk. No such sudden change or disappearance as is claimed by Mr. Clark is known to such river men as I have been able to consult.

In 1880 the steamer E. W. Cole and barges were aground at "Armstrong's." In 1881 the White Eagle was aground until relieved by another boat. In 1882 the steamer Mary Morton was aground just below the head of the Sny for thirty-one hours, and the Josie was aground for the same period. Many other boats have also had trouble in this locality since 1872.

Unless some improvements are made, I believe as much trouble will be experienced in this piece of river in the future as in the past, for the section is as full of sand as ever, and the channels are continually shifting. Mr. Clark refers to the grounding of steamer Andy Johnson in 1871. The Johnson was a large and powerful boat, drawing 4 feet light. She was on her way to Quincy to go into winter quarters, struck a snag opposite Armstrong's Island, and being unable to reach Quincy in her damaged condition was put in best winter quarters in the vicinity.

The opinions adopted by Mr. Clark and some others relative to the changes in condition of the river about the year 1872 are, I think, partially due to the fact that previous to 1872 they depended almost entirely on steamboats, railroad communication being imperfect. Any delays were at that time very noticeable. In late years, railroad communication having become convenient and rapid, but few have depended on steamboats during low water, and delays have passed unnoticed.

Again, since 1872, a much lighter class of boats has come in use, and navigation has been greatly facilitated by the establishment of lights and day beacons and the removal of snags and obstructions.

Without the evidence of those familiar with the facts, I should, from my own experience with shifting bars, &c., have arrived at the conclusion that such a sudden and radical change as was reported by Mr. Clark could not result from the closing of the Sny Slough. It is true the closing of side sloughs and concentration of water at low stages form an important part of the plans under which we are now working, but slow and gradual effects, proportionate in amount to the volume of water added to main channel, alone are expected. I am not informed as to the relative size of the Sny Slough and main river in 1871, but Mr. Corthell estimates the cross-section of slough at a medium stage to have been 6 per cent. of that of the river. Recent measurements show the cross-section of slough as compared with river to vary from 1 per cent. at low water to about 5 per cent. at a 10-foot stage, which brings water to top of banks. Supposing the entrance to the Sny Slough to have been open at all stages, the amount of water carried by it would have been comparatively small, especially at stages when the additional water was desirable in the main river, but I am informed the entrance to slough was obstructed by a bar to such an extent that at low stages parties interested in a water power on the slough were obliged to keep communication open with shovels.

My experience leads me to assert that such extensive improvements as are claimed by Mr. Clark do not result from such slight causes as the closing of the Sny; and this is further shown by the fact that at many points below the bars under consideration, but still within the influence of the levees, as below Louisiana, at Gilbert's Island, Slim Island, &c., the river has been much worse since the construction of the levees than ever before.

As regards the general effect of the Sny Levee on the Upper Mississippi, excepting when it confines water to the main river during low-water stage, I cannot see that it can in any way benefit the low-water channel. The obstructions do not, as on the lower river, consist of sediment carried in suspension, but almost entirely of sand rolled along the bottom. When the river is high, and bars all covered, low-water channels are more or less obliterated. As the water falls and the bars appear, low-water channels are again cut out. If the fall is rapid, temporary difficulty is almost sure to result. If the fall is gradual, a low-water channel is apt to be made by the time it is needed. Each high water will produce changes of channel, and often entirely change the troublesome localities.

To confine the water which would otherwise, for a very brief period, escape over the banks during high stages might possibly have a slight effect on the movement of the sand, but such additional movement would be injurious rather than beneficial. It would simply be increasing the causes which now tend to injure low-water navigation. If the river could be prevented from ever exceeding a medium stage, or the stage at which a general movement of sand takes place, navigation would be very much better than it now is. While the closing of the Sny Slough and any other side channel by the Sny Levee has not played the very important part assigned it by Mr. Clark, it must be admitted that if maintenance of the work were guaranteed by the Government it would be benefited to a certain extent, as the Sny Slough, and perhaps other outlets, would, in accordance with approved plans, be closed in time by brush and stone dams built to a height of 5 or 6 feet above low water.

The probable cost of such work would properly represent the benefit conferred on navigation by the Sny Levee, if made secure.

If by the expenditure of such an amount such parts of the levee as are performing useful work, in connection with river improvement, could be made secure, the expenditure would, in my opinion, be justifiable. But a personal examination leads me to believe that such work as could be legitimately done would not secure the levee, and without such security the work itself would be thrown away.

It does not seem to me that any claim for work done in the interest of navigation can be properly considered by the United States until the portions of work which are of benefit to navigation are made secure for all time, nor should the amount of such claim exceed the cost of such work as, in the absence of the Sny Levee, the Government would have built.

I am willing, so far as my judgment may be accepted, in locating work, and circumstances will permit, to select for protection such points of the bank as threaten the security of the Sny Levee. Some work of this nature has already been done, and work at other points is contemplated this season.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF SNY ISLAND LEVEE ON THE MISSISSIPPI RIVER.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., January 26, 1885.

GENERAL: The river and harbor act approved July 5, 1884, provided for an examination or survey as follows:

> Sny Island Levee, on the Mississippi River; and the Secretary of War shall report what benefit, if any, this levee has been to the improvement of the channel and navigation of the river, and he shall submit an estimate of the probable cost of strengthening and preserving said levee so as to assure and maintain that benefit.

By letter dated Office Chief of Engineers, July 31, 1884, I was charged with the preliminary examination of the item above referred to.

Under date of September 9, 1884, I submitted the preliminary report called for, stating, in effect, that, in my opinion, the Sny Levee, *as a levee*, had had no material influence on the low-water navigation of the Mississippi River; but as portions of this levee acted as dams, closing certain sloughs which formerly possibly carried off water needed *in the low-water channel*, I recommended a survey and investigation to determine, as accurately as possible, what sloughs had been closed.

By letter dated Office Chief of Engineers, November 21, 1884, I was charged with the examination recommended, and an amount was granted for the surveys assigned me, which permitted the allotment of $250 for the investigation of the Sny Levee and its effect on the navigation of the Mississippi River.

A party was put in the field January 9, 1885, and completed their work January 17. This party passed over the line of the levee and, by measurements and examinations of original profiles and records, determined as nearly as possible the extent of the sloughs crossed by the Sny Levee. The small amount of funds available, the season of the year, and the unusual high water were unfavorable to the survey, but it is believed all desirable information was obtained. The Sny Levee lies on the left or east bank of the Mississippi River, commencing at a point in Illinois about 9 miles south of Quincy and extending in a southerly direction about 51 miles, to Hamburg Bay. This levee was begun in 1872, and completed in 1875, that portion of it above Hannibal being finished early in 1873. It gave way in several places in 1876 and at later periods, and it has been a source of anxiety ever since it was built to those whom it was supposed to protect from overflow. The information desired by Congress is:

(1) What benefit, if any, this levee (the Sny) has been to the improvement of the channel and the navigation of the river.

(2) What is the probable cost of strengthening and preserving said levee so as to assure and maintain the benefit.

The condition of the Mississippi River, between the head of the Sny and Hamburg Bay, since 1875 is a matter of record. A detailed survey of this stretch was made in 1878, and numerous additional surveys at special localities have been made since that year. If any accurate and detailed surveys had been made previous to 1873, a comparison could be given, showing any changes occurring subsequent to the completion of the levee; but no such surveys are available, and a study of the question of the effect of the Sny Levee on general navigation must be based on official records and the experience gained since the Government commenced the radical improvement of the river.

The records show that since the levee was constructed, at points within its influence, most serious obstructions to navigation have either grown up or continued to exist until improved or removed by the work of the Government. Notable among such points are Gilbert's Island, vicinity of Louisiana Bridge, and Slim Island. Obstructions at these points have been as serious as any known to the memory of navigators. The formation of these obstructions is in no way charged to the Sny Levee, but that the levee did not prevent their formation, or remove them, is a fact. The records also show that the movement of sand-bars and natural changes of channel are governed by the same laws within the limits of the Sny Levee as on other portions of the river, and that such natural changes in this, as in all other portions of the Upper Mississippi River, frequently cause troublesome navigation where the channel was formerly good, and *vice versa*.

The only claim as to general improvement along the whole line of the levee, that has come to my notice, is that of its former engineer, but this claim is fully disproved by records and the opinions of all parties having any reliable information regarding the section of the river considered.

A claim as to the effect of the levee on a special bar above Hannibal is presented in a letter addressed to the Senate Select Committee on the Mississippi River, and printed with the report of the committee (Senate Report No. 36, Forty-eighth Congress, first session), commencing on page 13. The substance of this letter is the same as of one presented to the Mississippi River Commission, and considered by me in a report submitted to the Chief of Engineers, under date of May 14, 1884. The claims advanced are in effect that, previous to the year 1873 navigation between Quincy and Hannibal was very troublesome during low water, but that in 1873 a great change took place, and navigation in the formerly troublesome river became easy, and has remained so to the present time. This great change is attributed to the retention in the natural channel, by the construction of the Sny Levee, of an amount of water given in various communications of the claimants as one-twentieth, one-sixteenth, 8 per cent. and 10 per cent. of the flood-discharge.

Observations taken in 1883 show the cross-section of the Sny Slough at its head to be 1.1 per cent. of that of the main river at low water, 3¼ per cent. at a 6-foot stage, and 4.8 per cent. at a 10-foot stage. Experience has positively demonstrated that while great changes may take place from natural causes, no such rapid and radical improvements as are claimed result from such slight additions to the volume of the river as are here to be considered. As a matter of fact, the section of river claimed to have been permanently improved has been very troublesome at times since the levee was built. It is wide and full of shifting bars, and permanent improvement over it can never be assured until works in the bed of the river secure such a width *at low water* as will maintain a proper depth.

In considering the relation of the Sny Levee to navigation, it must be remembered that the conditions which exist on the lower river, and permit arguments in favor of levee construction, are not found on the

Mississippi north of the mouth of the Missouri, where the water is comparatively free from sediment, and where obstructions consist mainly of sand, not carried along rapidly in suspension, but slowly rolled along the bottom. The principle, often stated, that the "concentration of the flood-waters is the most powerful agent that can possibly be utilized in the deepening of the channel," may possibly find application in the lower river, but not in the Upper Mississippi. In the latter stream, high water and floods obliterate *low-water channels*, and low water cuts them out. Concentration may cause, in special localities, excessive scour, with a corresponding filling up below, as was the case at Louisiana Bridge, but no rapid general scouring is practicable; for, to secure any general lowering of the bed, the sand now forming the bottom and bars either must be moved at its slow pace the entire length of the river, or be provided with places of rest in its route down-stream.

Troublesome navigation on the Upper Mississippi results from the movement of sand-bars and the too great width of the natural low-water channel. Any increase of movement of sand, excepting such comparatively small amount as is necessary for clearing out low-water channels, is injurious rather than beneficial. A part of the plans under which improvements are now being carried on is to retard, as far as possible, this sand movement, and provide places of deposit where the accumulated sand will not injure low-water navigation.

Low-water channels are not developed until low stages are reached, and dependence for forming such channels cannot be placed on works which come into play only when the river is over its banks, as is conclusively shown at numerous points on the Upper Mississippi, where the river is confined at all stages by bluffs and high banks, forming natural levees. And at such points examples can be found where the river is continually troublesome, while at other points, where the high water overflows the banks at its pleasure, navigation is good.

While it is apparent that no general good to navigation has resulted from the construction of the Sny Levee, it is a fact that the levee crosses certain sloughs which the Government might, in the course of time, have determined to close with properly located brush and stone dams built to a height of 6 feet above low water, not that the amount of water carried off by these sloughs played any very important part in the question of river improvement, but for the reason that if not closed they might possibly deepen or become wider in future. The portions of the earthen embankment of the levee, which, at a 6-foot stage and under, prevent the escape of the water from the river, may, even though improperly located and not durable, be considered as adjuncts of river improvement, provided they can be made permanent and secure at no greater cost than the amount which the Government would have expended for accomplishing desired results. If a greater expenditure at present or in the future were involved, it would appear more wise for the interests of the Government to construct new works. In conclusion I would respectfully submit the following:

(1) The Sny Levee has not, *as a levee*, benefited navigation, but there are portions of the embankment which may be accepted as closing-dams when made secure, and as such will, theoretically at least, benefit navigation.

(2) The cost of such work as will strengthen the above-mentioned portions of the levee so as to provide a permanent benefit to navigation depends on its nature and amount. The estimate which, in my opinion, most nearly satisfies the requirements of the Congressional inquiry is

one for placing 6,278½ cubic yards of rock, at $1.50 per yard, and 5,678½ cubic yards of brush, at $1.25 per yard, amounting in all to $16,515.85.

These amounts are such as would have been required to close the four sloughs, heretofore referred to, in accordance with the Government methods.

Accompanying this report is a map* compiled from former surveys of the Land Office; of General Warren, Colonel Macomb, and Major Farquhar, of the Engineer Corps, and of the levee engineers. This map shows sections, &c., from notes of the present examination, and detailed estimates for closing the sloughs covered by it.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Z 15.

PRELIMINARY EXAMINATION WITH A VIEW TO REMOVAL OF THE BAR AND OBSTRUCTIONS AT AND NEAR THE MOUTH OF WHIPPLE CREEK, IN QUINCY BAY, ILLINOIS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 10, 1885.

SIR: The river and harbor act of July 5, 1884, provides, in section 9, for an examination and survey, with estimates of cost of improvement proper to be made, for the removal of the bar and obstructions at and near the mouth of Whipple Creek, in Quincy Bay, Illinois, and at the same time, in section 1, makes special provision for this improvement to be made in accordance with the plans and recommendations of the Mississippi River Commission.

In compliance with the requirements of section 9 of the act, instructions were given from this office to Maj. A. Mackenzie, Corps of Engineers, at the time in charge of the improvement of that part of the Mississippi River, to make a preliminary examination of the locality, and I have the honor to submit herewith his report thereon; but inasmuch as the supervision of this improvement has passed to the Mississippi River Commission, and Congress has provided for the commencement of the work, I have not considered myself authorized to take further action in the matter.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers, Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF MAJOR A. MACKENZIE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., September 8, 1884.

GENERAL: In reply to your circular letter of July 31, 1884, requesting estimates of funds required for certain preliminary examinations provided for by the river and harbor act of July 5, 1884, I have the honor to report as follows regarding "removal of the bar and obstructions at and near the mouth of Whipple Creek, in Quincy Bay, Illinois."

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*Omitted.

I am familiar with the locality, and have in my possession sufficient facts for a consideration of the question of a survey, &c. I do not consider any preliminary examination necessary.

The location of Whipple Creek is shown on the accompanying sketch. Material brought in by this creek has formed a large bar at its mouth in Quincy Bay. Quincy Bay is undoubtedly worthy of improvement, and Congress has for several years made appropriations for carrying on work in that locality, but the entire removal of the bar at the mouth of Whipple Creek has not heretofore formed a part of the plan of improvement, and no such work has been suggested by me in any reports.

Congress at its last session added to the original project for improving Quincy Bay the removal of the bar at the mouth of Whipple Creek; it may, therefore, be assumed that the interests involved are considered of sufficient importance to justify the work. My present opinion is that the interests involved are of a local rather than a general importance, and that the original project for the improvement of Quincy Bay, as submitted by Maj. F. U. Farquhar, Corps of Engineers, will furnish a winter harbor sufficient in extent to satisfy the general interests of commerce and navigation. But inasmuch as Congress has inaugurated this work, it would seem to me proper that such a survey be made as will enable me to prepare estimates of cost for removing the bar and obstructions in Quincy Bay at the mouth of Whipple Creek.

The expenses of such a survey and of the collection of information as to interests to be served will be about $100.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Z 16.

REPORT IN REFERENCE TO PRELIMINARY EXAMINATION OF THE MISSISSIPPI RIVER IN THE VICINITY OF GUTTENBERG, IOWA.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., August 23, 1884.

GENERAL: As instructed by circular letter dated July 31, 1884, I have the honor to submit the following report concerning an item of survey contained in river and harbor act of July 5, 1884, under title as follows:

> From Guttenberg north, for the ascertainment of needed improvements and in securing a direct channel pointing to Guttenberg and by way of that channel south, and the protection of improvements already made at that locality, Iowa.

Being familiar with the locality, and having at hand considerable information, no *preliminary* examination is needed.

The Mississippi River at Guttenberg, Iowa, is divided into two parts, one, which is in reality the main river, being known as "Guttenberg Channel," the other as "Cassville Slough."

Guttenberg Channel is used during certain stages by steamers desiring to reach Guttenberg, which is a shipping point of some importance, and by rafts as long as the stage of water permits. These latter select it as being wider, more direct, and easier to run.

Cassville Slough has been the *low-water* channel for more than fifteen years.

On account of the great amount of sand deposited in the Guttenberg Channel, and the consequent great cost attending its improvement at present, but little work on that side of the river has as yet been attempted, the principal work in this locality having been confined to the improvement of the foot of Cassville Slough. Since the Government began work in this vicinity by the improvement of the bar at foot of Cassville Slough through navigation has experienced no difficulty from insufficient depth of water, although sharp bends in the slough have been troublesome to rafts. Work near head of Guttenberg Channel enables boats to reach Guttenberg from the north, but there is insufficient water at low stages to permit them to continue on their way south. The lumber interests prefer the adoption of the Guttenberg Channel as the main channel, and other interests would be as well served by such adoption; but in this case, as in many others, it is necessary and proper to choose the right time for the work, a time when the river itself seems inclined to take the desired direction, and when it may be made to do a great part of the necessary work through its own volition, and by waiting for this opportunity much expense is saved.

Inasmuch as the work is certainly a legitimate one, as taken in connection with the general improvement of the river, and as the Guttenberg Channel is undoubtedly worthy of improvement, and, further, as the important lumber interests of the river are deeply interested in the work, I would recommend a survey of the locality which will permit a full report on expense and interests involved.

The section of river under consideration is about 12 miles in length, and such a survey and examination as is required can be made for about $500.

If this amount is greater than can be assigned to this work, a portion of the expense can be borne by the general apropriations under which I am working, which provide for surveys made in connection with improvements carried on.

I inclose sketch of the locality in question, taken from our atlas map.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF THE MISSISSIPPI RIVER IN THE VICINITY OF GUTTENBERG, IOWA.

UNITED STATES ENGINEER OFFICE,
Rock Island, Ill., January 22, 1885.

GENERAL: In accordance with instructions contained in your letter of November 21, 1884, I have the honor to report on a survey "from Guttenberg north, for the ascertainment of needed improvements, and in securing a direct channel pointing to Guttenberg, and by way of that channel south, and the protection of improvements already made at that locality."

Accompanying the report is a map of the survey, showing on a scale of $\frac{1}{4800}$ the stretch of river mentioned, which is about 12 miles in length.

On the map are laid down the curves of 4.5 feet at low water and the low-water shore-line.

It being known that the survey would be required, and funds being available for the purpose from the general appropriation for improving Mississippi River from Saint Paul to Des Moines Rapids, a party was put in the field October 21, 1884, and completed the field work November 10, before very cold weather had set in.

The Mississippi River at Guttenberg, Iowa, is divided into two parts, one, which is in reality the main river, being known as "Guttenberg Channel," the other as "Cassville Slough." Guttenberg Channel is used during certain stages by steamers desiring to reach Guttenberg, which is a shipping point of some importance, and by rafts as long as the stage of water permits. These latter select it as being wider, more direct, and easier to run. Cassville Slough has been the *low-water* channel for more than fifteen years; and since the Government began work in this vicinity, by the improvement of the bar at foot of Cassville Slough, through navigation has experienced no difficulty from insufficient depth of water, although sharp bends in the slough have been troublesome to rafts.

The lumber interests prefer the adoption of the Guttenberg Channel as the main channel, and other interests would be as well served by such adoption; but in this case, as in many others, it is necessary and proper to choose the right time for the work, a time when the river itself seems inclined to take the desired direction, and when it may be made to do a great part of the necessary work through its own volition, and by waiting for this opportunity much expense is saved.

The work of improving the Guttenberg Channel may be properly considered as a part of the adopted system of improvements of through navigation, and could be carried on under the general appropriations for the Mississippi River from Saint Paul to Des Moines Rapids, were they sufficiently large to justify a suitable allotment for this locality. The work is desirable, and has not been undertaken heretofore because boats and rafts could, even at lowest stages, pass through Cassville Slough, and it was not deemed proper to divert any part of the small appropriations to this section of the river, while at many other points navigation at low stages was greatly impeded or effectually blocked.

It would be impossible to indicate on the map a detailed project for improvement at this locality which would not be liable to perhaps a radical change within a few months, owing to the shifting nature of the channel, and therefore no attempt is made at the present time to establish the location of dams and shore protections. But by use of the methods adopted and heretofore prosecuted in the improvement of the Upper Mississippi River, the estimated cost to give a channel of 6 feet at low water is $20,000 per mile, and for the whole stretch of river in question $240,000. This estimate per mile is somewhat larger than is usually given, inasmuch as this part of the river is more than commonly clogged by sand-bars, has several miles of cutting bank, which should be protected, and eight shallow channel crossings.

Very respectfully, your obedient servant,

A. MACKENZIE,
Major of Engineers.

THE CHIEF OF ENGINEERS, U.S.A.

APPENDIX A A.

PRESERVATION OF THE FALLS OF SAINT ANTHONY AND IMPROVEMENT OF THE MISSISSIPPI ABOVE THE FALLS—IMPROVEMENT OF CHIPPEWA AND SAINT CROIX RIVERS, WISCONSIN, AND OF MINNESOTA RIVER AND RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA—RESERVOIRS AT THE SOURCES OF THE MISSISSIPPI.

REPORT OF MAJOR CHARLES J. ALLEN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Preservation of Falls of Saint Anthony, Minnesota.
2. Mississippi River above the Falls of Saint Anthony, Minnesota.
3. Construction of lock and dam on Mississippi River at Meeker's Island, Minnesota.
4. Chippewa River, Wisconsin.
5. Chippewa River at Yellow Banks, Wisconsin.
6. Saint Croix River below Taylor's Falls, Minnesota and Wisconsin.
7. Minnesota River, Minnesota.
8. Red River of the North, Minnesota and Dakota.
9. Lock and dam at Goose Rapids on Red River of the North, Minnesota and Dakota.
10. Reservoirs upon the headwaters of the Mississippi River and its tributaries.
11. Surveys for reservoirs at the sources of the Mississippi, Saint Croix, Chippewa, and Wisconsin rivers.

ENGINEER'S OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., July 18, 1885.

GENERAL: I have the honor to forward herewith annual reports upon the works and surveys under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

A A 1.

PRESERVATION OF THE FALLS OF SAINT ANTHONY, MINNESOTA.

The first appropriation by Congress towards preserving the Falls of Saint Anthony was $50,000, made by act approved July 11, 1870.

The plea for appropriations was that destruction of the falls would convert the river above them into a succession of rapids, to the destruction of navigation.

The recession of the limestone crest of the falls was due almost entirely to the undermining of the soft underlying sand-rock, the ledge caving in piecemeal and more rapidly in the middle of the stream than at the banks.

The rate of recession was accelerated by the action of the water-power companies chartered by the Territorial legislature in 1857, which companies occupied the bed of the river with dams, sluices, and other works, restricting its width for the practicable discharge of water to about one-third of its natural width, forcing the greater part of the discharge through a channel 450 feet wide at the crest, narrowing down to about 360 feet at the foot of the timber apron afterwards built, and through a height of about 45 feet, to act upon the comparatively soft bed of the stream below. In low water the greater part of the discharge was drawn through the sluices, the limestone ledge between the dams and the crest of the falls being often left nearly bare in winter and exposed to rapid disintegration from the action of frost.

In 1866 an attempt was made by the water-power companies to protect the crest by a timber apron, which was destroyed by the ensuing high water. A second attempt, in 1869, was defeated by high water.

In the fall of 1868 an attempt was made by private parties to construct a tunnel through the soft sand-rock under the ledge of the Hennepin Island, to form a race for mills to be placed on Nicollet Island, above Hennepin, the water to be discharged through the tunnel below the falls at the foot of Hennepin Island. On October 4 the tunnel had progressed about 2,000 feet, reaching a point near the foot of Nicollet Island. Here the water burst into the tunnel by passing under the limestone near the southwest side of Nicollet Island, and the tunnel soon became a roaring sluice way. Those having the excavation in charge had neglected the precaution of lining as the work progressed, in addition to which, from supposed motives of economy, the excavation commenced at the lower instead of the upper end. This disaster was followed by irruptions of water washing out the soft sand-rock, causing caving of the limestone in a number of places. The mill-owners and citizens expended much time and money—of the latter, so far as can be ascertained, about $334,000 in all—in attempts to avert the threatened disasters. The appropriations by Congress up to and including that by act approved March 3, 1873, were applied in attempts to exclude the water from the breaks already made, as well as from new ones, by surrounding them with coffer-dams, filling up the chasms, &c., the details of which are given on pages 1161–1165, Appendix S, Part II, Annual Report of the Chief of Engineers for year ending June 30, 1879. The total of appropriations by Congress prior to 1874 was $200,000.

The river and harbor act of Congress approved June 23, 1874, appropriated, "for continuing the improvement of the Falls of Saint Anthony and for the improvement of the Mississippi River above the Falls of Saint Anthony, Minnesota, $150,000," and it directed that $25,000 of said amount be expended for the improvement of the Mississippi River above the falls.

The present plan for the preservation of the falls, adopted in 1874, contemplated the construction of a concrete dike beneath the limestone ledge forming the bed of the river, to prevent percolation through, and consequent destruction of, the soft underlying sand-rock, the construction of rolling-dams to keep the upper surface of the limestone ledge flooded during the winter, and a timber apron and wings to prevent recession of the crest of the falls and destruction of the dike, &c. The dike was completed in 1876 and the other works by 1878. Since

1878 work has been confined mainly to the preservation and repair of the timber structures.

A log sluice was constructed at the westerly side of the main apron, under an appropriation of $10,000 for that purpose by act of Congress approved March 3, 1879.

The condition of the falls, as shown by examinations made in September and November, 1884, was stated in a report dated December 5, 1884, to which, with the map accompanying, reference is here made. The report was printed as House Ex. Doc. No. 61, Forty-eighth Congress, second session.

The deposits by private parties of rock, earth, and gravel referred to in that report, are described in the annual reports for 1882 and 1883.

The appropriation of $10,000 made by the river and harbor act of Congress approved July 5, 1884, was applied, so far as it would go, in repairs to the main apron, the angle, and the east-wing apron, which had become completely undermined.

The repairs to the main apron consisted in stripping off the plank covering where most worn and replacing with new plank; of oak, where the danger from wear appeared greatest, and of pine at other points.

The repairs to the east-wing apron consisted in strengthening it by driving timbers, 12 inches square and 24 to 40 feet in length each, vertically, by the aid of a pile-driver, through the underlying mass of slabs, bark, and sawdust which had accumulated under and behind the apron, filling the crib pockets with riprap, and replanking the crib-work. The heavy square timbers were driven within the pockets, as close together as possible, and on lines parallel to the face of the wing, and also on lines at right angles to the face. In addition to the riprap filling of the east wing, 520 cubic yards of large stone, of 10 cubic feet and more in size, were placed along the outside face and lower side of the wing, to support it, and to break up, as far as possible, the powerful eddy which aided in the undermining process.

This work was done by hired labor and completed in March last. The details of the work and general statement of its condition are given in the reports, herewith, of Assistant R. Davenport, who displayed commendable energy in pushing it during the severe winter months.

The timber work is generally in fair condition, though the ice and logs have, since March last, worn off some of the 4-inch decking of the main apron, exposing to wear the next layer, 8-inch, which is all that protects the cribs below it. The stone crib filling under the main apron has settled or moved out since 1877, in some places having subsided 7 to 15 feet. Should the 8-inch plank, from any cause, give way, rapid destruction of the apron would probably follow.

The present plan for the aprons and roll-dams, as stated in the report of December 5, 1884, referred to above, is based upon the preservation of the private mill-dams, the flanks of the Government works resting upon those dams, some of which are now leaky and in generally bad condition. Especially is this the case with portions of the mill-dam bordering what is known as Farnham and Lovejoy's Pond. This dam is in bad condition, liable to give way with the first heavy flood, and is a menace to the apron below it, and consequently to the entire work.

There seems little probability of the parties owning this dam doing anything to strengthen it.

A glance at the map of the falls will show that portions of the width of the river (about 1,000 linear feet in the aggregate) are occupied by high dams of the companies, so that the flow of water through those works is only in small quantities, through flumes, &c., as may be desired, while the brunt of the flood discharges is borne by the United States works spanning the narrow width of 450 feet.

A radical change of plan of exterior works of protection (understanding by these the apron, wings, and rolling-dams), and such as would best serve to preserve the falls, would call for the removal of most, if not all, the mill-dams from the bed of the stream, the extension of the rolling-dams from bank to bank, and a large extension of apron work, to consist either of timber or of concrete.

If the Government adheres to the present plan of exterior works for protecting the falls, the sum of $150,000 will be needed for the fiscal year ending June 30, 1887, to be expended toward extending the main apron to the front of Farnham and Lovejoy's Mill Pond; protecting this front, so far as necessary; removal of a portion of the point of rocks from the river near the lower end of the pond in order to reduce the eddy; repairing the main apron and east apron, continuing the line of submerged cribs across the bed of the river at the toe of the apron, and for general repairs. One crib, 80 by 80, was completed during the winter of 1882 and 1883, and successfully sunk, after the manner of a caisson, in March, as described in the annual report for 1883. The total cost of work of protection here estimated as necessary is placed at $210,000.

The estimated cost of the present plan, adopted in 1874, as stated in the last Annual Report, was $419,792.*

The same report stated that the appropriations made since 1880 inclusive were not considered in determining the amounts still to be appropriated to complete the present project, as those appropriations had been, and were to be, expended for repairs and contingencies; the appropriation of 1879 was for log-sluice.

The appropriations applied to the original construction of works under the plan of 1874 were as follows:

By act approved June 23, 1874	$125,000
By act approved March 3, 1875	100,000
By act approved August 14, 1876	120,000
Total	345,000
Leaving as difference between estimated cost of complete plan and amounts appropriated for same	74,792
	419,792

The expenditures of appropriations from the commencement may be thus summarized approximately:

Under plans prior to that of 1874	$200,000
Under plan of 1874, which is the present plan	345,000
Construction of log-sluice, under specific appropriation for same by act approved March 3, 1879	
In repairs to and maintenance of the works, including large cribs, 1878–1885	†60,000
The total of appropriations by Congress for the Falls of Saint Anthony is	615,000

The cost of works regarded as immediately necessary for continuing the preservation of the falls under the existing plan being $210,000, it becomes necessary to present this sum as a new estimate.

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*This amount ($419,792) is taken from Report of Chief of Engineers, 1874, Part I, page 285. The original estimate for the present plan has been stated in previous annual reports at $529,726.31.

†Of this amount the sum of $9,926.72 was expended during the fiscal year ending June 30, 1885, exclusive of outstanding liabilities July 1, 1884.

ABSTRACT OF APPROPRIATIONS MADE FOR SAINT ANTHONY FALLS.

By act approved July 11, 1870	*$50,000
By act approved March 3, 1871	*50,000
By act approved June 10, 1872	*50,000
By act approved March 3, 1873	*50,000
By act approved June 23, 1874	125,000
By act approved March 3, 1875	100,000
By act approved August 14, 1876	120,000
By act approved March 3, 1879	†10,000
By act approved June 14, 1880	‡10,000
By act approved March 3, 1881	‡15,000
By act passed August 2, 1882	‡25,000
By act approved July 5, 1884	‡10,000
Total	615,000

This work is in the collection district of Minnesota. The nearest port of entry is Duluth, Minn., at which place the revenue collected during the year ending December 31, 1884, amounted to $4,125.63.

No steamboats have navigated the river between the Falls of Saint Anthony and Aitken, about 208 miles by river above the falls, for six or seven years, excepting, so far as known, one steamer which made an excursion trip last season, from Brainerd to Fort Ripley, a point about 133 miles above the Falls; hence there is no navigation dependent upon the preservation of the Falls. The commercial statistics of Minneapolis, therefore, refer entirely to the products of the water-power, and shipments of lumber, flour, groceries, &c., by rail.

Money statement.

July 1, 1884, amount available		$472 84
Amount appropriated by act approved July 5, 1884		10,000 00
		10,472 84
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,926 72	
July 1, 1885, outstanding liabilities	86 83	
		10,013 55
July 1, 1885, amount available		459 29

Amount (estimated) required for completion of existing project	210 000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	150 000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORTS OF MR. RUFUS DAVENPORT, ASSISTANT ENGINEER.

1.

SAINT PAUL, MINN., *April* 15, 1885.

SIR: The following report of the work done at the Falls of Saint Anthony, repair of apron, &c., during the winter of 1884–'85, and accompanying map, is respectfully submitted:

The repairs on the east wing apron consisted in driving a row of piles of 12 by 12 inch square timber, from 24 feet to 40 feet long, along and parallel to the face of the apron a short distance back from the water line, with rows of piling at right angles to the face-wall, extending back as far as they could be driven, and the introduction of riprap filling back of the piles. In all 93 piles were driven.

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* These sums were used before the adoption of the present plan.

† For sluice-way through public works, &c.

‡ For repairs and contingencies, &c., and are not considered in determining the amounts still to be appropriated to complete the present project.

The piles were put in as close together as the apron timbers would permit, and
driven as far as they would go with a 24 foot stroke of a 2,300-pound hammer.
driving varied in depth, according to nature of the bottom encountered, from
to 14 feet. The ends of the piles, above the water-surface, were bolted to all
crib timber that could be reached, and to each other, with 1½-inch drift and
bolts. The material driven through was sand, riprap, slabs, and sawdust; the
tom finally reached appeared to be mostly stone and sand.

Three hundred and twenty-two cubic yards of riprap were put in back of the
of piling, as shown on map.

The introduction of the riprap and the pile driving necessitated the remov
24,000 feet, B. M., of the covering plank, 4-inch and 8-inch, all of which was rep
in good shape.

The lower end of the east wing apron was found to be filled with a compact
of logs, slabs, bark, and sawdust, which was, as far as possible, removed to
place for the riprap.

In addition to the riprap placed in the interior of the east wing apron 520
yards of large stone, 10 cubic feet and upwards in size, were placed along the
side face and lower side of this apron.

The riprap along the face of the apron has an average width on top of abo
feet and has an average elevation of about 1 foot above low water; that on the
side, projecting out into the river in the shape of a wing-dam, has an average
of 20 feet on top, is 4 feet above low-water level at the outer end, and 9 feet a
low water at the junction with the rocky shore.

One hundred and thirty cubic yards of the large riprap were quarried fro
rocky point below the east wing apron with the view of making a free outlet f
water and of breaking up, as far as possible, the eddy at the lower side of the a

A sluice-way was built in the angle between the east wing-apron and the lime
ledge to carry off the water that at times comes over the dam from the Farnham
Lovejoy's Mill Pond, and a small apron, 100 feet long and 5 feet wide, was built
the opening (caused by the settlement of the apron) between the ledge and the
to prevent the water from cutting away the soft rock that supports the lime
ledge.

In addition to the repairs on the east wing apron, a portion of the main apron
replanked, 35,000 feet, B. M., of 4-inch oak plank and 16,000 feet, B. M., of 4-inch
plank being laid and secured.

As shown on map, the oak plank was laid in the "angle" and along the
end of the apron parallel with the Roll Dam, the places in which the old plan
showed the greatest wear.

The oak plank was laid out along the lower side of the Roll Dam as far as th
and water would permit. Considerable trouble was experienced during the prog
of the work from water and ice, the partial shutting down of the mills on Sund
&c., causing the water to rise from 1 foot to 4 feet on the lower Roll Dam, at t
flooding the work and causing the formation of large masses of ice on the portio
the apron that was being repaired.

The West Side Mill Power Company, however, did all they could to keep the
running steadily and prevent injury to the work.

Very respectfully, your obedient servant,

R. DAVENPORT,
Assistant Engine

Maj. CHAS. J. ALLEN.

2.

SAINT PAUL, MINN., *April* 20, 18

SIR: The following report of the condition of the aprons at the Falls of Saint
thony, with an estimate of the probable cost of repairing them, is respectfully
mitted.

The entire area of the main apron west of that portion repaired this spring, a
62,000 square feet, should be replanked as soon as possible. Of this area a stri
feet long and 20 feet wide along the lower end of the Roll Dam should be cov
with oak, as logs and ice in passing from the Roll Dam to the apron make a sligh
or plunge, which is very destructive to the soft pine of the apron.

The 4-inch planking, in the area inclosed by the dotted lines on the map, a
upper end of the apron, is entirely worn out, and the 8-inch timber, the only rem
ing covering on the cribs, is being rapidly cut away. If a passage should be for
by the destruction of the 8-inch timber covering, for any considerable volume of w
into the interior of the apron cribs the effect on the apron below would, without do
be very disastrous. It is more than likely that a large portion of the lower west
which is in bad condition, and is known to be nearly empty of stone filling, woul

carried away. The area at the lower west end of the apron inclosed by the dotted lines on the map has settled considerably, and, in places, is 4 feet or more below its original level. An examination by the watchman at the falls, near the point marked E on the map, disclosed the fact that the riprap, with which the apron cribs had originally been filled, had at that point disappeared. The distance from the surface of the apron to the water surface was about 15 feet and there was no stone in sight; how much below the surface of the water the rock had settled was not reported.

Soundings, made this spring, at the points marked on map A, B, C, and D, show that the rock filling has settled at those points from 3 feet to 7 feet.

From the facts given above it is believed that on examination the foundation-cribs, at the lower west end of the apron, will be found to be nearly empty of stone.

The disappearance of the stone filling is believed to be caused, in part, at least, by the action of the water that passes through the openings between the 8-inch timber, when the 4-inch planking has been destroyed; these openings are from one-half inch to 1½ inches in width, and are caused by the natural shrinkage of the timber, and the cutting action of the water, sand, &c., passing between them. By the constant action of these small streams of water the limestone filling is destroyed and washed away. In winter ice forms under the apron, assisting materially in the destruction of the stone.

The repairs made on the east wing apron during the winter just passed, it is believed will be sufficient to insure its stability for two or three years, provided that the Farnham and Lovejoy Mill Pond Dam does not give way and flank the work. This dam is in very bad condition, is liable to give way with the first flood that comes, and is a constant menace to the apron below it, if not to the entire work.

The ice in the pond during the winter just passed appears to have injured this dam very materially, as the leaks at the several points have increased largely in volume. The section near the waste-way at the lower end of the dam was moved out horizontally about 1½ feet, and an opening made in the face of the dam through which a large volume of water passed. This opening has been closed with 2-inch plank, and the leak partially stopped, but nothing has been done to strengthen the dam. To permanently repair this section of the apron, the east wing, it would be necessary to tear it up and rebuild it, as the injury and decay have been confined mostly to the foundation, and as it is believed it would not be advisable to rebuild it in its present shape, the estimate submitted for this portion of the work is for the removal of the east wing, the extension of the main apron to the east side and the protection of the limestone ledge on that side by a wall of masonry.

It would, however, be useless to do work of any magnitude on this side, the east wing, *until after a permanent high dam is built along the west line of the Farnham and Lovejoy Mill Pond.*

The estimated cost of the work is placed at a price at which it is believed the work can be done under ordinary circumstances; a liberal margin should, however, be allowed for possible trouble with high water in summer, or with ice and water in winter.

For the purpose of comparison an estimate of the cost of thoroughly repairing the east-wing apron, as it is now constructed, is added.

A considerable item of expense in the construction of new work will be the removal of the stone and timber of the old cribs, though it is believed that enough sound material can be obtained from the old work to pay the cost of removal.

An estimate of the cost of placing submerged cribs along the "Toe" of the apron, is also added to the estimated cost of the repairs.

ESTIMATE OF THE COST OF REPAIRS AT THE FALLS OF SAINT ANTHONY.

(1) *Main apron.*

Replanking:	
228,000 feet, B. M., 4-inch pine plank, at $19 per M	$4,332
20,000 feet, B. M., 4-inch oak plank, at $30 per M	600
50,000 oak or elm pins, at $15 per M	750
Total	5,682

(2) *Leveling up main apron and refilling cribs with riprap.*

Removing and replacing 8-inch covering timbers:	
250,000 feet, B. M., at $10 per M	$2,500
116,000 feet, B. M., 12 by 12 inch timber, in work, at $20 per M	2,320
20,000 feet, B. M., 8 by 12 inch timber, at $14 per M	280
25,000 oak pins (2-inch), at $40 per M	1,000
12,000 cubic yards of stone, riprap, at $2.50 per cubic yard	30,000
	36,100

(3) *Submerged apron cribs.*

370 linear feet of submerged cribs at the "Toe" of the main apron, at $1.20 per linear foot	$44,400

(4) *East wing apron.*

Removal of east wing and extension of main apron:	
740,000 feet, B. M., 12 by 12 inch timber, in work, at $20 per M	$14,800
134,000 feet, B. M., 8 by 12 inch timber, in work, at $20 per M	2,680
60,000 2-inch oak pins, at $40 per M	2,400
67,000 feet, B. M., 4-inch pine plank, in work, at $19 per M	1,273
13,000 oak pins for 4-inch pine plank, at $15 per M	195
10,000 cubic yards stone, riprap, in work, at $2.40 per cubic yard	24,000
18,000 cubic yards excavation, limestone and sand rock, at $1 per cubic yard	18,000
4,000 cubic yards masonry, at $15 per cubic yard	60,000
	123,348

SUMMARY.

(1) Replanking main apron	$5,682
(2) Leveling up main apron and refilling cribs with riprap	36,100
(3) Submerged apron cribs	44,400
(4) Removal of east wing and extension of main apron	123,348
Total	209,530

ESTIMATED COST OF REPAIRING EAST WING APRON ACCORDING TO THE PRESENT PLAN OF CONSTRUCTION.

800,000 feet, B. M., 12 by 12 inch timber, &c., in work, at 20 per M	$16,000
48,000 feet, B. M., 4-inch plank at $19 per M	912
10,000 oak pins for 4-inch plank, at $15 per M	150
56,000 oak pins for timber, at $40 per M	2,240
6,000 cubic yards stone, riprap, at $2.40 per cubic yard	14,400
	33,702

Very respectfully, your obedient servant,

R. DAVENPORT,
Assistant Engineer.

Maj. CHAS. J. ALLEN.

REPORT UPON THE PRESENT CONDITION OF THE FALLS OF SAINT ANTHONY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 17, 1884.

SIR: I have the honor to submit the inclosed copy of a communication to this office, dated the 5th instant, from Maj. C. J. Allen, Corps of Engineers, in regard to the condition of the Falls of Saint Anthony, based upon examinations of the Government works at that locality made during portions of the months of September and November, 1884, with recommendation that it be sent to the Speaker of the House of Representatives for the information of the Committee on River and Harbors, and such action as the case may seem to require.

Major Allen shows very clearly the dangerous condition of the Falls and the necessity that measures be taken at an early day for their protection and preservation. He states, also, that much of the injury to the Falls is due to the obstructions caused by deposits of rock, earth, and gravel, made by private parties in Minneapolis, above the apron, during the winter of 1881-'82, &c.

Copy of the drawing accompanying his report is also submitted herewith.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF MAJOR CHARLES J. ALLEN, CORPS OF ENGINEERS.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., December 5, 1884.

GENERAL: I beg leave to submit the following report upon the condition of the Falls of Saint Anthony:

Examination of the Government works were commenced in September last, but a sudden rise in the river deferred further examination until the latter part of November.

The apron has settled in a number of places; the planking of the apron and angle nearly all needs renewing, and the timber-wing at A—B is entirely undermined and dilapidated. (Please see tracing herewith.)

The principal works constructed by the Government for the preservation of the Falls are:

1. A concrete dike, about 1,870 feet long, extending entirely across the width of the river, under the limestone ledge of the Falls, to prevent the cutting away of the soft sand rock underlying the limestone. This dike was completed in 1876.
2. Rolling dams, completed in 1876, and designed to maintain, during the winter season, sufficient depth of water over the limestone to prevent injurious action upon it of ice and frost.
3. A timber apron and wing at and below the crest of the Falls to prevent undermining of the sand rock and consequent recession of the crest.

The angle, as it is called, has always been regarded as the most exposed point in the Government works on account of its proximity to the extensive break of 1871 under the limestone; it is also less than 150 feet distant from the concrete dike, for the protection of which the apron and wing were constructed.

The erosion and undermining in the angle and along A—B are largely due to the effect of deposits of rock, earth, and gravel made in the channel of the river above the apron in the winter of 1881 and '82, by private parties in Minneapolis, the material deposited infringing 118 feet upon the already too narrow water-way and throwing an undue proportion of the discharge of water into the angle.

The erosion, since the winter of 1881 and 1882, just below the wing, at the point marked E on the tracing, is undoubtedly due, to some extent, to the effect of the deposits just mentioned, but more particularly to an attempt, during that winter, by parties claiming the right to the water-power on the east side to tunnel under Farnham and Lovejoy's Mill Pond. An injunction, served at the instance of the parties using the mill pond, stopped the tunneling, but the excavation had progressed far enough to expose a small face of sand rock to the action of high water, so that, since the winter of 1881 and 1882, the limestone ledge has receded about 40 feet. A strong eddy sets into the bay thus excavated and, passing under the timber work A—B, contributes materially to the undermining now going on.

The deposits made in the channel above the apron have been noted in the annual reports since 1882, inclusive. Suit was commenced in the United States district court in the spring of 1882 to compel the removal of the deposits, which removal was finally effected during the summer and fall of 1883.

It can be seen by the tracing herewith that the mills and other private works occupy about two-thirds of the bed of the river, and that through the remaining third (the middle of the stream) the flood, as well as low-water volumes, must discharge, such quantities excepted as may be drawn through the mills for working the wheels. Thus volumes of from 5,000 to 40,000 cubic feet of water per second plunge over the apron, through a width of 450 feet, narrowing to 350 feet at the foot of the apron, and through heights of 40 to 45 feet, to act upon the soft sand rock forming the bed of the river below the falls.

Many of the water-power companies' dams are leaky and in dilapidated condition, and although they contract the bed of the river, as already stated, the preservation of the Government works under their present plan and extent largely depends upon the preservation of the mill-dams. The rolling dams, apron and wing, abut or rest upon dams built by the corporations or companies. Should the dams belonging to the latter go to pieces, through neglect or otherwise, the Government works would be flanked by the stream and ultimately destroyed. For example, the rolling dams, built for the purpose of keeping the limestone ledge flooded during winters in order to prevent frost and ice from scaling off the top layers of the limestone, abut against the mill and water-power companies' dams at the points D, F, G, and H. Should the companies' dams not be maintained, the rolling dams would be flanked and rendered null for the purposes for which they were built, and, besides, the water flanking the rolling dam and apron at the points H, H, H, for instance, where the mill-dam is much dilapidated, would add to the undermining in the angle and below it, and so on for other parts of the crest occupied by works of private parties. As the erosion proceeds the limestone crest recedes, the concrete dike is neared, and all the protection works are endangered.

I have at different times, and especially within the past two months, communicated with the representatives of the mill and water power companies as to the dangerous condition of the Falls. So far as I understand the matter, the control of the water power on the east side is in litigation, and until the questions involved are settled by the courts, no improvement of consequence in the condition of the private dams can be looked for.

Congress made the first appropriation for the preservation of the Falls in 1870, since which time the Government has expended upon them about $600,000 in extensive works.

In view of the increasing difficulties encountered in preserving the Government works at the Falls of Saint Anthony, I feel it a duty to call attention to the necessity of adequate appropriations, as estimated for in the annual reports of the engineer in charge, as well as to the necessity of legislation to prevent abuse of, or trespass upon, the Government works.

The last Congress appropriated for "Improvements at the Falls of Saint Anthony, Minnesota, repairs to and preservation thereof,

$10,000." This sum is totally inadequate for repairs immediately necessary. It will, however, be applied, this winter, to replanking the angle and strengthening the wing A—B, in the hope of tiding over the spring floods.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

A A 2.

IMPROVEMENT OF THE MISSISSIPPI RIVER ABOVE THE FALLS OF SAINT ANTHONY, MINNESOTA.

The present plan under which work has been carried on since and including 1880 is based upon the project for the improvement of the river from Conradi's Shoals to Grand Rapids; the estimated cost, $54,127.50, as given in the report of February 8, 1875, upon part of the third subdivision, Mississippi Transportation Route to the Seaboard. Plan of improvement to afford 3 to 5 feet of water by removal of snags, bowlders, and bars.

This same report estimated the cost of improvement of the river between the Falls of Saint Anthony and Saint Cloud at $144,667.50.

Plan of improvement of this section, or stretch, to afford 5 feet of water at low stage in the channel by removal of sand, gravel, and bowlder bars and the construction of wing-dams. The sum of $20,000, appropriated by act of Congress approved August 14, 1876, was expended between the Falls of Saint Anthony and Saint Cloud, the latter place about 1½ miles below Sauk Rapids. Prior to the rendition of the report and estimate of February 8, 1875, Congress appropriated, by act approved June 23, 1874, the sum of $25,000 for the improvement of the river above the Falls of Saint Anthony, which amount was also expended between the falls and Saint Cloud.

Steamboat navigation having almost discontinued between the falls and Saint Cloud, the next appropriation made by Congress, that by act approved June 14, 1880, of $15,000, was applied to the stretch of river above Conradi's Shoals (the work confined to the river between Aitken and Grand Rapids), as have been also all subsequent appropriations. This recital explains the form of the abstract and expenditure of appropriations here rendered.

The last appropriation for this work was $10,000, by act of Congress passed August 2, 1882. The small balance, $951.43, available at the commencement of the past fiscal year, only sufficed for the removal of a limited number of obstructions from the channel at Grand Rapids and for the general care of the floating and other engineer property until the latter could be sold at public auction in September last, its value not apparently warranting the expense of guarding it in anticipation of future appropriations for continuing the work.

The obstructions at Grand Rapids, referred to, were removed during November by hired labor. They consisted of 620 cubic yards of bowlders drilled and blasted and otherwise removed. The work was well done by Mr. C. L. Harrison, overseer. Steamers and flats can now ascend the rapids; the former at ordinary stage and the latter at low stage of water.

Amount expended on the present project to June 30, 1885 (including outstanding liabilities)	$34,748 10
Amount expended on the present project during the fiscal year ending June 30, 1885 (including outstanding liabilities)	699 53

Before work of improvement commenced under the present project the stream between Aitken and Grand Rapids, a distance of 160 miles, was obstructed by snags, bowlders, and bars, and the bends by leaning trees or sweepers. At low water, and even at higher stages, navigation was difficult for boats drawing not more than 2 feet. There is now a general depth of 3 feet at low water in the channels between Aitken and Grand Rapids, though many masses of bowlders and gravel yet require removal. Snags form more or less every season, and caving bends furnish leaning trees or sweepers. Ice, breaking up in the spring, also causes the deposit, more or less, of bowlders in the channel.

The sum of $15,000 can be profitably expended during the fiscal year ending June 30, 1887, in removing obstructions between Aitken and Grand Rapids, the steamboats appearing to be confined to this piece of river.

This work is in the collection district of Minnesota. The nearest port of entry is Duluth, Minn., at which place the revenue collected during the year ending December 31, 1884, amounted to $4,125.63.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING MISSISSIPPI RIVER ABOVE FALLS OF SAINT ANTHONY, MINNESOTA.

By act approved June 23, 1874		*$25,000 00
By act approved August 14, 1876		*20,000 00
By act approved June 14, 1880		15,000 00
By act approved March 3, 1881		10,000 00
By act passed August 2, 1882		10,000 00
Total		80,000 00
Original estimate for the work between Grand Rapids and Conradi's Shoals		54,127 50
Appropriations by acts:		
June 14, 1880	$15,000 00	
March 3, 1881	10,000 00	
August 2, 1882	10,000 00	
		35,000 00
Remaining to be appropriated		19,127 50

Money statement.

July 1, 1884, amount available		$955 10
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$699 53	
July 1, 1885, outstanding liabilities	3 67	
		703 20
July 1, 1885, amount available		251 90
Amount (estimated) required for completion of project, viz, improvement between Grand Rapids and Conradi's Shoals		19,127 50
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

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* Made and expended before the adoption of the present project.

COMMERCIAL STATISTICS, 1884.

Lumber, shingles, and lath manufactured on the Mississippi River above the Falls of Saint Anthony.

Articles.	1880.	1881.	1882.	1883.	1884.
Lumber ....feet B M..	241, 157, 989	339, 162, 197	428, 009, 250	398, 178, 995	389, 970, 574
Shingles..............number..	88, 446, 125	128, 532, 050	168, 844, 000	132, 202, 450	123, 487, 300
Lath.......................do....	49, 423 100	70, 380, 750	77, 898, 000	83, 193, 825	101, 087, 360

LOGS, 1884.

The logs run during 1884 between Minneapolis and Saint Cloud amounted to 325,000,000 feet, valued at $2,437,500.

The logs run on the river above Saint Cloud amounted to 42,000,000 feet, valued at $315,000.

STEAMBOAT NAVIGATION, 1884, BETWEEN AITKEN AND GRAND RAPIDS, MINNESOTA.

There were two steamboats, with their barges, engaged in the carrying trade during 1884.

Navigation opened April 19 and closed November 13. The steamboats made twenty-one round trips, and carried freight amounting to 16,000,000 pounds. Character of freight: Groceries, feed, machinery, tools, supplies, &c. The number of passengers carried is stated at 1,346.

A A 3.

CONSTRUCTION OF LOCK AND DAM ON MISSISSIPPI RIVER AT MEEKER'S ISLAND, MINNESOTA.

The project for this work is given in the Report of the Chief of Engineers for the fiscal year ending June 30, 1874, and the cost estimated at $922,121.46, the object being to connect with the improvement of the Mississippi River below Saint Paul, so as to secure steamboat navigation up to the Falls of Saint Anthony.

No improvement of the river between Saint Paul and site of the proposed lock and dam has been authorized by Congress.

Congress, by act approved July 23, 1868, made a grant of 200,000 acres of public lands to the State of Minnesota to aid in constructing a lock and dam at this point in accordance with plan and estimate previously submitted.

By act approved March 3, 1873, Congress appropriated—

> For construction of the lock and dam on the Mississippi River, at Meeker's Island, Minnesota, according to the surveys and plans of the War Department, $25,000: *Provided*, That all rights and claims in and to the land grant made to the State of Minnesota for the above work by act approved July 23, 1868, shall be fully relinquished to the United States before any of this appropriation is expended.

None of this appropriation has been used, the required relinquishment not having been made.

This appropriation is but little more than 2½ per cent. of the estimate, and has been lying unused for twelve years.

No appropriation is recommended for the fiscal year ending June 30, 1887.

This proposed work is in the collection district of Minnesota. The nearest port of entry is Duluth, Minn., at which place the revenue collected for the year ending December 31, 1884, amounted to $4,125.63.

Beyond the running of loose saw-logs, there are no commercial statistics to report.

Money statement.

July 1, 1884, amount available	$25,000 00
July 1, 1885, amount available	25,000 00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	922,121 46

A A 4.

IMPROVEMENT OF CHIPPEWA RIVER, WISCONSIN.

This work consists in the construction of dams and jetties to confine the low-water discharge to a practicable channel, and revetment of banks with brush and stone in accordance with the original plan of improvement adopted in 1876.

The original estimate for the improvement of the Chippewa River between Eau Claire and the mouth was placed at $139,892.50, of which $64,102.50 was the cost of protecting the Yellow Banks. The protection of the Yellow Banks has since been made a separate work. Deducting this item, the original estimate for improving the river alone reduced to $75,790.

The revised estimate (see page 1440, Appendix X, Annual Report, 1883) for completing the work was $49,476.35, the improvement mainly to embrace the extent of river from Dunnville to the mouth, thus bringing the estimated cost up to $132,476.35.

Wherever works have been constructed the low-water channel has been benefited, a depth of 3 feet being generally maintained where before improvement the depth seldom exceeded 18 inches. The improvement has been principally confined to the extent of river between the mouth and Durand. The jetties at the mouth of the river have been of incalculable benefit to raft and steamboat navigation, in giving a stable channel where before improvement commenced there was a broad bar with shallow, shifting channels. A number of shoals on this extent of river still need improvement.

The work of improvement during the past fiscal year consisted in repairs to the east and west jetties at the mouth of the river and extension of revetment above the east jetty, repairs to Flower-Pot Dam, Battle Island Dam, Dead Lake Cut-off Dam, and Three Mile Prairie Revetment, construction of two jetties, 1,000 linear feet in all, opposite Durand, and removal of obstructions from Shaw's Rapids, at the lower end of Eau Claire. Of these obstructions at Shaw's Rapids part were removed during the fall of 1884 and part in May following.

MATERIAL EXPENDED DURING THE YEAR.

	Cubic yards.
Stone	2,938
Brush	3,943

The balance of appropriations available will be applied during the coming season to extension and repair of existing works.

The greater part of the work during the fiscal year was in local charge of Assistant Vine D. Simar, who zealously carried out instructions given him. His report of operations is herewith.

With the exception of some needed improvement of the channel at Shaw's Rapids the improvements most needed are of the bars and crossings between Durand and the mouth of the Chippewa.

The sum of $30,000 can be profitably expended during the fiscal year ending June 30, 1887, in furtherance of the present plan of improvement.

This work is in the collection district of Milwaukee, Wis. The collections for this district for the year ending December 31, 1884, amounted to $206,032.42, of which amount $191,341.92 was for duties, and $14,690.50 for custom-house fees.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING CHIPPEWA RIVER, WISCONSIN

By act approved August 14, 1876	$10,000
By act approved June 8, 1878	10,000
By act approved March 3, 1879	8,000
By act approved June 14, 1880	10,000
By act approved March 3, 1881	10,000
By act passed August 2, 1882	35,000
By act approved July 5, 1884	15,000
	98,000

Revised cost of improvement under original, which is also the present plan, was placed at $132,476.35.

Total amount expended to June 30, 1885 (including outstanding liabilities), $96,289.37.

Money statement.

July 1, 1885, amount available		$1,107 11
Amount appropriated by act approved July 5, 1884		15,000 00
		16,107 11
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$14,376 48	
July 1, 1885, outstanding liabilities	20 00	
		14,396 48
July 1, 1885, amount available		1,710 63
Amount (estimated) required for completion of improvement per revised project		34,476 35
Amount that can be profitably expended in fiscal year ending June 30, 1887		30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. VINE D. SIMAR, ASSISTANT ENGINEER.

SAINT PAUL, MINN., *March* 31, 1885.

SIR: Pursuant to your orders of August 10, 1884, in company with Assistant Engineer F. T. Hampton, an examination was made of the Chippewa River from Durand to the mouth. The river at that time was at low stage, giving a good opportunity for the examination of existing works, which disclosed a break in the revetment at Three Mile Prairie and settlements at Flower Pot Dam and east jetty, the two requiring immediate attention.

The steamer Minnie Heerman was chartered and went into commission August 30; the same day an examination was made of the boom and pocket placed within and near the mouth of the Chippewa River by the Mississippi Logging Company; at that time it proved to be no material obstruction to navigation, although traces of the formation of a bar across the channel, a short distance below the boom, were found, which developed later on, and after the high-water flood of September last; and by a change of the channel it became necessary to remove the pocket, which has since been done by the parties controlling it.

Steps were at once taken to repair the settlements at east jetty and Flower Pot Dam. Upper Flower Pot was found some 6 feet low for a distance of 200 feet. East jetty near the head was 5 feet low, for a distance of 90 feet; while the west jetty was found to be from 1 to 2 feet low for a distance of 800 feet.

Repairs of east jetty and Flower Pot Dam were completed September 12, and work commenced on repairs of west jetty.

The river being at flood height, work was suspended, and your instructions to make certain repairs at Waubeek Yellow Bank were carried out. This consisted in placing 150 cords of brush and as many cubic yards of stone upon, and crowning, the most exposed portion of the dock. After the high water had subsided, some slight settlement of the dock at another point was found, which has since been repaired at a cost of $25, making the total cost of repairs and care of Yellow Banks for the season of 1884, $423.86.

The works at Rumsey's Landing and Meridian are in fair condition, but should be completed to obtain the benefit of the improvements made.

The high water of September 12 last, caused by heavy and continuous rains throughout the valley of the Chippewa River and its watershed, was higher than before known by 2 feet at Durand. Very great damage was done throughout the valley; some of the holding-dams, used by the logging companies above Chippewa Falls, gave way, letting loose large quantities of logs and an increased volume of water, adding materially to the general bad results of the flood.

After receiving your orders to proceed to Eau Claire to remove certain obstructions at Shaw's Rapids, we arrived there September 21 with steamer and crew, having left one crew of men at Waubeek Yellow Bank to prosecute the repairs to the dock at that place. Upon examination of the channel at Shaw's Rapids, we found the channel which formerly ran near the left bank, and to the left of a large gravel bar, had changed to the right bank, caused by the movement of the bar down-stream by the high-water flood. The new channel was obstructed by numerous boom piers, placed near their mill some years since by the Daniel Shaw Lumber Company, for holding logs for milling purposes. We found 9 feet of water on the rapids, making the removal of the obstructions by blasting (the only effective way) somewhat difficult.

After removing those piers causing the most serious obstruction and opening a channel, we suspended operations until October 18, when a detached party was located there to remove the remaining obstructions by blasting; the water still being at a stage of 5 feet on the rapids, it was found impracticable to bore the piles as is usually done to secure lodgment for the charge. We, instead, used one-fourth inch iron bent into rings to fit the piles; to these rings from 2 to 4 cartridges of giant powder were made fast with fuze attached; they were then dropped over the piles and placed at the bottom and discharged; in this way the remaining piers were effectively removed, giving a free channel.

The banks on the right at this point should be protected by revetment, they being soft and easily destroyed by the rapids. A jetty or training-dam would, I think, secure a permanent channel.

Work was resumed on repairs of west jetty October 4 and completed October 1 1884.

The following week work upon the new jetties at Durand was commenced. Two jetties were constructed, the upper one located 700 feet below Goodrich's Point, the lower one located 1,100 feet farther down-stream and 800 feet above the highway bridge. The jetties extend 500 feet from the right bank and confine the channel to a width of 700 feet at low water. The water at the upper jetty has a head (March 5) of .5 foot and has about the same elevation as at Goodrich's Point, 700 feet up-stream. In constructing the jetties bulkheads were placed at the axis of jetties, joining them well into the banks; for this we used brush 24 feet long well anchored with stone. We used the same length of brush for the greater portion of the jetties, giving them a base of 38 feet. The Durand Bar or crossing has been greatly improved by the construction of these jetties. There now exists in its place 6 feet of water (at low stage), with a permanent channel.

Sandstone of good quality was obtained at Rocky Point, some 5 miles up-stream. The jetties are substantially built, and can be maintained at a slight cost for repairs. Work was completed November 22. The same day we left with steamer and barges for Read's Landing. Some difficulty was encountered the day following in getting through, the light rain of the 22d turning to snow that evening, the mercury indicating —7° the next morning, with ice running. We, however, succeeded in getting out without damage.

Upon the discharge of steamer and barges, the work of repairing the revetment at Three-mile Prairie was commenced, some 400 feet requiring renewals, this, as also some repairs to Battle Island Dam, was completed during the month of December. During the month of January the bank at the head of east jetty, mouth of Chippewa River, was revetted for a distance of 120 feet from the head of the jetty up-stream, making that work secure from flanking by high water. The dam at Dead Lake cut-off was repaired against greatest damage by high water by placing brush and stone at its point of greatest settlement, near the lower bank.

Materials consumed:	Cubic yards.
New work:	
Stone	1,617
Brush	2,031
Repairs:	
Stone	1,321
Brush	1,912
Total for construction and repairs:	
Stone	2,938
Brush	3,943

During the season of 1884 most difficulty to the passage of rafts occurred at Flower Pot Bar, foot of Battle Island, Mark's Bend, and mouth of Bear Creek. Flower Pot Bar might be improved by extending the Little Missouri Dam down-stream 150 feet to cut-off and turn the water (which strikes there from the upper Flower Pot Dam) to the right and main channel, which runs nearly parallel with the lower Flower Pot Dam, while a narrow channel runs close to the Little Missouri Island.

The channel at Bear Creek Bar was very narrow. At Mark's Bend the river is wide and the bar very "flat."

All existing works are in good condition to withstand the spring freshets.

Very respectfully, your obedient servant,

VINE D. SIMAR,
Assistant Engineer.

Maj. CHAS. J. ALLEN,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS, CHIPPEWA RIVER, 1884.

298,344,591 feet B. M. lumber, at $14 per M feet	$4,176,824 27
88,905,520 laths, at $2 per M	177,811 04
160,133,000 shingles at $2.50 per M	400,332 50
1,840,278 pickets, at $12 per M	22,083 34
534,674,176 feet B. M. logs, Beef Slough, at $10 per M feet	5,346,741 76
	10,123,792 91

Steamboats commenced running April 14, 1884, and ceased running November 16, 1884. Two steamboats were engaged in the freight and passenger business. Freight carried, 750 tons. The steamboat that plied regularly between Read's Landing and Dunnville reports 5,000 passengers carried. The other steamboat made only one hundred trips in all, but does not give the number of passengers carried. The amount received for freight and passengers is given at $9,908.

A A 5.

IMPROVEMENT OF CHIPPEWA RIVER, AT YELLOW BANKS, WISCONSIN.

The object of this work is to prevent the wearing away of the high sandbanks or bluffs on the Chippewa River, below Eau Claire, and thereby relieve this river and the Mississippi, below the junction of the two rivers, from the masses of sand contributed by these banks.

The original estimate of the cost of this work was $64,102.50, as given in the report upon the cost of improving the Chippewa River, January 30, 1875. This estimate was increased, for reasons given in the Annual Report of 1883, Appendix X 5, page 1443, to $96,000, instead of the former figures.

The plan of protection authorized February 7, 1883, consists in rows of piles driven at the foot of the slope at distances of 5 feet apart from center to center. Between these piles and between the line of piling and foot of the slope are laid fascines of brush with sand well incorporated with them. The finished brush-work is carried up to a height of 10 to 12 feet above low-water mark. On top of the brush saplings are laid parallel to the line of the piling; across these saplings are ties, two for every 5 feet in length of protection wall, firmly spiked to the piles and to pickets driven in rear of the protection wall. Willow slips were planted at the foot of wall and sand scraped up behind it. It is expected that the sand from the banks will keep a tight packing against the brush-work so as to obviate the necessity of using any large quantities of rock or gravel, which are expensive. The summit, however, should be crowned with rock. A few mill-edgings were used at the outset of the work, but they proved as expensive as brush, if not more so, and not so effective.

The condition of the work may be stated as follows:

At Waubeek Yellow Bank, 2,989 feet long, the protection has been completed.

At Rumsey's Yellow Bank, 4,500 feet long, the piles are all driven, and 1,850 linear feet of the protection completed.

At Mary Dean Yellow Bank, 6,900 feet long, 625 feet have been piled and 130 feet of the protection completed.

Two banks near Eau Claire, aggregating 8,300 feet in length, have been untouched, leaving a total of about 14,575 linear feet, upon which no work has been done.

Some slight repairs to the Waubeek Bank protection were made during the past fiscal year by hired labor.

The sum of $30,000 can be profitably expended during the fiscal year ending June 30, 1887, in continuing the protection, especially of Rumsey's and Mary Dean banks.

This work is in the collection district of Milwaukee, Wis. The collection for this district for the year ending December 31, 1884, amounted to $206,032.42, of which amount $191,341.92 was for duties, and $14,690.50 for custom-house fees.

Revised estimate of cost of improvement	$96,000 00
Appropriated by act passed August 2, 1882	30,000 00
Remaining to be appropriated	66,000 00
Total amount expended to June 30, 1885, including outstanding liabilities	29,703 41

For commercial statistics see annual report of operations "Improving Chippewa River, Wisconsin."

Money statement.

July 1, 1884, amount available		$785 12
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$483 86	
July 1, 1885, outstanding liabilities	4 67	
		488 53
July 1, 1885, amount available		296 59

Amount (estimated) required for completion of existing project	66,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

A A 6.

IMPROVEMENT OF SAINT CROIX RIVER BELOW TAYLOR'S FALLS, MINNESOTA AND WISCONSIN.

The original project for the improvement of this river, adopted in 1878, was based upon the results of a survey made in 1874, and contemplated the removal of snags, bowlders, wrecks, leaning trees, and sandbars between Taylor's Falls and Prescott, and the contraction of the low-water channel between Taylor's Falls and Stillwater into one of nearly uniform width by means of brush and stone jetties, and dams of same material to close island chutes and secondary channels.

The present project, adopted in 1880 and modified in 1882, is based upon the results of a survey made in 1879, the resulting estimate (see page 1444, Appendix X, Annual Report, 1883) being $83,450.

The first appropriation for the improvement of the Saint Croix was $10,000, by act of Congress approved June 18, 1878.

At that date the channel, above Stillwater especially, was incumbered by sunken cribs, wrecks, snags, &c. The low-water channel had in many places but little more than 2 feet depth, and steamers and barges made their way as best they could amongst the obstructions.

The result of the work to date is a least depth upon the bars on the 30 miles above Stillwater, wherever improvements have been made, of 3 feet at low water, and at Hudson and Catfish bars, on the 27 miles of river below Stillwater, of 5 feet. Generally it may be said of the work done that at many places navigation has been made permanent where formerly it was uncertain, and that in other places it has been made practicable, where before improvement it was impossible.

Some few bars and crossings above Stillwater yet require improvement, and about one-half mile of bank above Harriman's Landing requires revetment to prevent the river from breaking through into a new channel and obliterating the present one.

Below Stillwater the pile sheeting and brush training-dam should be extended for at least 2,000 feet and the lower part of the channel dredged; and the improvement at Catfish Bar should be completed by constructing a permanent training-wall of brush and stone from a point on the right bank, above the mouth of Bowles' Creek to the channel dredged across the bar, to concentrate the flow upon this channel and also to divert to the right bank the deposits from the creek.

The work for the past fiscal year commenced in July by the removal of 133 sunken logs from the channel between Taylor's Falls and Lakeland.

In the latter part of August work was resumed at Hudson Dam and Catfish Bar and was closed by high water in the early part of October.

During the brief season's work, 1,000 linear feet of the pile dam at Hudson were sheeted with 3-inch pine sheet-piling, leaving 150 feet of the lower end of the dam unsheeted. About 45,000 feet B. M. of sheeting, 1,200 pounds of spikes, and 60 cubic yards of stone were used in this work.

At Catfish Bar 3,900 cubic yards of gravel and sand were removed by scraper from the new channel, making its full width 600 feet, 400 feet of which width had a depth of 5 feet at low water.

The work was all performed by hired labor.

Material had been purchased and preparations made for a much longer period of work, but operations were very suddenly terminated by an unusual rise in the river.

In January, 1885, the work of closing a breach in the left bank above Harriman's Landing, was begun and completed in April; 612 cubic yards of stone and 116 cords of brush were used in the work.

Amount expended under present plan during fiscal year ending June 30, 1885 (including outstanding liabilities), $6,964.37.

The balance of appropriations available June 30, 1885, will be used during the coming season in keeping the channel at Catfish Bar open, and in necessary repairs to existing works.

The work for the fiscal year was in local charge of O. F. Knapp, overseer, and S. M. Register, pilot, both whom performed their duties well.

The sum of $26,450 can be profitably expended during the fiscal year ending June 30, 1887, in continuation of the present plan, in revetment

of banks above Harriman's Landing, and in construction of jetties and dams above Stillwater, and below Stillwater in extending the training dam at the Hudson Bar, dredging the bar, and in dredging Catfish Bar and in building the needed training wall or dam at that point.

Estimated cost of improvement as amended	$83,450 00
Amount expended before its adoption	18,000 00
Total amount expended under present plan to June 30, 1885, including outstanding liabilities	54,117 32
Total amount expended to June 30, 1884, including outstanding liabilities	72,117 32

This work is in the collection district of Minnesota. The nearest port of entry is that of Duluth, Minn., at which place the revenue collected during the year ending December 31, 1884, amounted to $4,125.63.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING SAINT CROIX RIVER BELOW TAYLOR'S FALLS, MINNESOTA AND WISCONSIN.

By act approved June 18, 1878*	$10,000
By act approved March 3, 1879*	8,000
By act approved June 14, 1880†	10,000
By act approved March 3, 1881	8,000
By act passed August 2, 1882	30,000
By act approved July 5, 1884	9,000
Total	75,000

Money statement.

July 1, 1884, amount available		$847 05
Amount appropriated by act approved July 5, 1884		9,000 00
		9,847 05
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,926 05	
July 1, 1885, outstanding liabilities	38 32	
		6,964 37
July 1, 1885, amount available		2,882 68

Amount (estimated) required for completion of existing project	26,450 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	26,450 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS, 1883 AND 1884.

FREIGHT AND PASSENGERS, 1883.

There were three steamboats and twenty-five barges engaged exclusively in the freight and passenger business during season of 1883. The steamboats made one hundred and forty-one round trips between Taylor's Falls and Stillwater, seventy-five between Marine and Saint Paul, and twenty between Franconia and Saint Paul. The steamboats are reported to have carried as follows:

Passengers	number	2,800
Miscellaneous freight	pounds	8,200,000
Lumber	feet, B. M.	10,500,000

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*Appropriated before adoption of original project, and the project based upon the report of the survey of 1879 (see report of Capt. Charles J. Allen, January 26, 1880, printed as House Ex. Doc. No. 40, Forty-sixth Congress, second session), and before the adoption of the existing project; cost, $83,450. Two thousand dollars of the appropriation of 1879 were used in making survey of the river from Taylor's Falls to Prescott during 1879.

†About $300 of this amount were expended in the improvement of the slough on the east side of the river, known as the canal, between Four Mile Island and the foot of Saint Croix Boom.

Live stock	head..	140
Rafting poles	number..	23,000
Wood	cords..	12,000
Lath	number..	25,000
Shingles	do....	75,000
Coal	tons..	100

The river was blocked with logs for a period of forty-five days in 1883, necessitating the laying up of steamboats a larger portion of the time. Had not this occurred the freight and passenger traffic would no doubt have been much greater.

NOTE.—It was found impracticable to procure the freight and passenger statistics for the year 1884. It is said, however, that the business was about one-third larger than in 1883.

LUMBER, LOGS, RAFTING, AND TOWING, 1884.

There were thirty steamboats engaged in the towing of logs and lumber during the season of 1884.

There were 175,000,000 feet, B. M., of logs and lumber towed out of the Saint Croix River during 1884, and 275,000,000 feet, B. M., of logs, valued at $2,750,000, were passed through the Saint Croix Boom.

Manufactured:

Lumber, 125,000,000 feet, B. M., at $12 per M	$1,500,000 00
Shingles, 25,000,000 pieces, at $2.50 per M	62,500 00
Lath, 25,000,000 pieces, at $1.75 per M	43,750 00
Pickets, 615,000 pieces, at $12.50 per M	7,687 50
Total	1,613,937 50

Opening and closing of navigation on the Saint Croix River.

Year.	Opened.	Closed.	Year.	Opened.	Closed.
1863	April 7	Nov. 20	1874	April 15	Nov. 15
1864	April 5	Nov 12	1875	April 12	Nov. 15
1865	April 8	Nov. 20	1876	April 18	Nov. 25
1866	April 10	Nov. 25	1877	April 8	Dec. 31
1867	April 10	Nov. 24	1878	April 2	Nov. 20
1868	Mar. 26	Nov. 25	1879	April 4	Nov. 17
1869	April 9	Nov. 13	1880	April 1	Nov. 13
1870	April 5	Nov. 21	1881	April 12	Nov. 14
1871	Mar. 29	Nov. 22	1882	April 3	Nov. 23
1872	April 8	Nov. 20	1883	April 12	Nov. 12
1873	April 5	Nov. 25	1884	April 1	Nov. 19

A A 7.

IMPROVEMENT OF MINNESOTA RIVER, MINNESOTA.

No work was done during the fiscal year for want of funds.

The project for the improvement of the river from its mouth to South Bend (see page 364, Part I, Annual Report of the Chief of Engineers for 1875) contemplated the construction of five locks and dams, and removal of snags, &c., at an estimated cost of $733,868.63. The last appropriation for this stream was made by river and harbor act approved June 18, 1878, and consisted of $10,000.

There has been expended (including outstanding liabilities) since the commencement of the work upon the stream the sum of $117,467.

The stream has no commerce worth reporting. No appropriation is asked for the fiscal year ending June 30, 1887.

This work is in the collection district of Minnesota. The nearest port of entry is Duluth, Minn., at which place the revenue collected during the year ending December 31, 1884, amounted to $4,125.63.

The commerce of the river, even before the advent of the railroad through the Minnesota Valley, was not large in any one season, and since that time only an occasional small "wild" packet has ascended the river.

In May, 1876, two steamboats that went up the river during high water had to discharge their return freight at Mankato before they could return to the Mississippi River, owing to the great number of snags and other obstructions.

With the appropriations by Congress August 14, 1876, and June 18, 1878, however, a large number of these obstructions was removed.

ABSTRACT OF APPROPRIATIONS MADE FOR THE IMPROVEMENT OF THE MINNESOTA RIVER.

By act approved March 3, 1867	$37,500
By act approved July 11, 1870	10,000
By act approved March 3, 1871	10,000
By act approved June 10, 1872	10,000
By act approved March 3, 1873	10,000
By act approved June 23, 1874 *	10,000
By act approved March 3, 1875	10,000
By act approved August 14, 1876	10,000
By act approved June 18, 1878	10,000
Total	117,500

Amount (estimated) required for completion of existing project (see page 364, Part I, Annual Report of Chief of Engineers for 1875), $703,868.63.

Money statement.

July 1, 1884, amount available	$42 00
July 1, 1885, outstanding liabilities	9 00
July 1, 1885, amount available	33 00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	703,868 63

A A 8.

IMPROVEMENT OF RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA.

The present, which is also the original, plan for the improvement of this river, from Breckenridge to the boundary line, consists in dredging the bars and removal of snags, leaning trees, and occasional bowlders. The estimated cost of this improvement, based upon the reports of 1874 and 1875, was $145,310.18, which estimate, as revised in the Annual Report of 1883, was increased by $34,000.

Under the appropriation of $10,000 by the river and harbor act of Congress approved July 5, 1884, the work of dredging was resumed below Grand Forks and continued to October 30, when, ice beginning to form, work was discontinued for the season. One dredge only was employed, it being thought necessary to confine the expense of repairs, always incident, more or less, upon the close of work of one season and resumption of the same, as much as possible.

The work commenced at a point about 18 miles below Grand Forks, and terminated for the season at a point 32 miles below Grand Forks.

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* Used in making survey of river.

Quantity of material removed by the dredge, 36,138 cubic yards; number of linear feet of bars excavated, 4,700; length of river worked, over 14 miles.

The material excavated, a tough, leathery clay, and not liable to rapid wash, was utilized, as in former years, in forming training and contraction dams. The work was done by hired labor. The season of 1884 was dry and the volume of water small. In view of the possibility of recurrence of such low water, it was deemed best to reduce the width of excavation below Grand Forks to 60 feet instead of 80 feet, as had been originally intended.

The total amount of work done upon this stream since the first appropriation of $10,000 for its improvement was made by act of Congress, approved August 14, 1876, is represented by 298,870 cubic yards of dredging (commenced in 1879) distributed over 112 miles of river between Moorhead and Fargo and Goose Rapids, and between Grand Forks and Pembina; also, removal of snags, bowlders, and leaning trees from 152 miles of river between Moorhead and Grand Forks; and 4,370 leaning trees and 219 snags removed early in 1880 between Moorhead and Fort Abercrombie, a distance of 76 miles; total extent of river worked upon, 260 miles. To these items may be added the removal of 321 cubic yards of bowlders from Goose Rapids in 1882 to assist navigation at a time when the water was very low.

GENERAL CONDITION OF THE WORK.

The 3-foot dredged channels from Moorhead to a point 80 miles north, averaging 60 feet in width, and the 4-foot dredged channels from Grand Forks to a point 32 miles north (distances by river), averaging 70 feet in width, are in good condition, and no difficulty is experienced at any stage by boats loaded for those depths. The removal of snags and trees between Moorhead and Abercrombie simply improved that portion of the stream for high and medium stages of water.

Generally since the first bars were dredged in 1879 the carrying of grain in barges has been greatly facilitated. Before the dredging commenced in 1879 there was but 1½ feet of water, ruling depth, upon the bars between Moorhead and Goose Rapids, and 2 feet on the bars below Grand Forks.

IMPROVEMENTS NECESSARY.

There are yet to be removed between Fargo and Breckenridge, a distance of 101 miles, large numbers of snags and bowlders and 40,000 cubic yards of clay bars to be dredged.

From Moorhead to Goose Rapids, 90 miles, estimated about 60,000 cubic yards of clay to be removed to open a continuous 3-foot channel to the head of the rapids.

From Grand Forks to the foot of Pelican Bars, 115 miles, estimated 164,000 cubic yards of dredging to secure 4-foot channel to Pembina.

Between Pelican Bars and Pembina, 48 miles, no improvement is deemed necessary at present.

Goose Rapids stands as a dividing wall between the upper and lower river; their improvement is discussed in the report upon lock and dam at Goose Rapids.

Total dredging required, about 275,000 cubic yards.

Total length of river (excluding Goose Rapids) to be cleared of snags and bowlders, about 101 miles.

All the work on this stream has been by hired labor. There are two dredging machines, one dredge tender, capable of being used as a steam derrick; one small steamer, and flats, belonging to the United States, engaged upon this work. This property has to be taken care of; it is subject to rapid deterioration unless repaired and used.

With the balance of funds from former appropriations it is proposed to continue operations during the rest of this season, so far as the funds will carry the work, reserving enough with which to guard the property through next winter.

The sum of $45,000 can be profitably expended during the fiscal year ending June 30, 1887, in continuing dredging operations and removal of obstructions generally below Moorhead and Fargo, and in dredging and continuing removal of snags, trees, and bowlders, between those points and Breckenridge.

Mr. Rufus Davenport, assistant engineer, deserves credit for zeal displayed in carrying out instructions in regard to this work.

The Red River of the North and its tributaries from their sources to the international boundary line, are wholly within the customs district of Minnesota, of which Saint Vincent is the chief port of entry.

The collections at the port of Saint Vincent and subports on the international boundary line for the year ending December 31, 1884, aggregate $16,000.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA.

By act approved August 14, 1876	$10,000
By act approved June 18, 1878	30,000
By act approved March 3, 1879	25,000
By act approved June 14, 1880	20,000
By act approved March 3, 1881	18,000
By act passed August 2, 1882	10,000
By act approved July 5, 1884	10,000
Total	123,000

Revised estimate of cost of improvement from Breckenridge to the boundary line, not including lock and dam at Goose Rapids, $179,310.18.

Total amount expended to June 30, 1885 (including outstanding liabilities), is $117,428.15.

Money statement.

July, 1, 1884, amount available	$2,137 39
Amount appropriated by act approved July 5, 1884	10,000 00
	12,137 39
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,565 54
July 1, 1885, amount available	5,571 85
Amount (estimated) required for completion of improvement per revised estimate, not including lock and dam at Goose Rapids	56,310 18
Amount that can be profitably expended in fiscal year ending June 30, 1887	45,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS, RED RIVER OF THE NORTH, BETWEEN BRECKENRIDGE AND THE BOUNDARY LINE, SEASON OF 1884.

There were two steamboat lines operating on the river during the season of 1884, the Grandin Line, one steamboat (the Grandin) and a fleet of barges, operating between Fargo, Dak., and the head of the Goose Rapids, and the Red River Transportation Company, two steamboats and a barge fleet, the steamboat (the Pluck) running north and south from Moorhead, Minn., and the other steamboat (the H. W. Alsop) runing north and south from Grand Forks, Dak. The following is a statement of the amount of freight moved by the different lines:

GRANDIN LINE.

	Pounds.
Merchandise carried down river from Fargo	247,240
Wheat brought up river to Fargo	25,925,056
Barley brought up river to Fargo	499,156

RED RIVER TRANSPORTATION COMPANY.

STEAMER PLUCK.

From points south to Moorhead:	
Wheat	9,074,410
Wood	1,545,000
From points north to Moorhead:	
Wheat	1,695,795
Wood	3,228,000
From Moorhead to points north and south:	
Merchandise	666,750

STEAMER H. W. ALSOP.

From Grand Forks north:	
Merchandise	1,401,810
Wood	3,231,000
To Grand Forks from points north:	
Merchandise	66,455
Wood	2,394,000
To Grand Forks from points north and south:	
Wheat	8,116,800
Total	58,091,472

RECAPITULATION.

Grandin Line (operating above Goose Rapids)	26,671,452
Red River Transportation Company (operating above Goose Rapids)	16,209,955
Red River Transportation Company (operating below Goose Rapids)	15,210,065
Total	58,091,472

COMPARATIVE STATEMENT OF FREIGHT CARRIED FOR SIX YEARS.

Total freight carried in—	Pounds.
1884	58,091,472
1883	50,627,951
1882	63,303,629
1881	53,114,861
1880	43,301,515
1879	35,718,731

A A 9.

CONSTRUCTION OF LOCK AND DAM AT GOOSE RAPIDS, ON THE RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA.

This proposed improvement was reported upon, with estimate of cost, December, 1877. The object of the work was to overcome the fall at the worst obstruction, near the head of the rapids, so as to connect with the dredging improvement of the river above and below the rapids. Estimate (1877) of cost, $219,287.99. Congress, by act approved March 3, 1881, appropriated the sum of $20,000 towards the work, and, by act passed August 2, 1882, made another appropriation for it of $30,000.

The total amount appropriated was considered too small in proportion to the probable cost of the work to warrant commencing operations;

in addition, cost of materials and labor had changed since the date of the first estimate, and more detailed information in regard to the rapids was required than had heretofore been obtained.

It was deemed advisable to make a thorough and detailed survey of the entire extent of the rapids, with a view to submitting to Congress a close estimate of the cost of improvement. A survey was made during the season of 1883, and a report thereon, with maps, submitted January 21, 1884. This report presented the cost of three plans for improving the rapids, as follows:

First:	Locks and dams at Buffalo Neck and Isabella Island	$476,378 49
	Dredging	4,750 00
	Total	481,128 49
Second:	Lock and dam at Buffalo Neck	261,378 49
	Dredging	12,750 00
	Total	274,128 49
Third:	Dredging the bars on the rapids and utilizing the dredged material for dams, training-walls, &c	30,000 00

A lock and dam on the rapids were first suggested in the report of March 4, 1874, at which date there had been no experience in dredging the obstructions and utilizing the material, such as was gained subsequently in dredging the river above and below the rapids, 1879–1882.

The report of January 21, 1884, also suggested for consideration the advisability of rendering the appropriations already made for a lock and dam available for dredging.

Should, however, the second plan of improvement, viz, lock and dam at Buffalo Neck and dredging approaches thereto, at estimated cost of $274,128.49, be ordered, the sum of $100,000, in addition to the amounts already appropriated, can be profitably expended during the fiscal year ending June 30, 1887, in preliminaries, excavation, foundations, &c.

Amount expended (in examinations) to June 30, 1885, is $3,052.35, which also is the total amount expended.

There are no operations to report for the year ending June 30, 1885.

The Red River of the North and its tributaries, from their sources to the international boundary line, are wholly within the customs district of Minnesota, of which Saint Vincent is the chief port of entry. The collections at the port of Saint Vincent and sub-ports on the international boundary line for the calendar year ending December 31, 1884, aggregate $16,000.

For commercial statistics of the Red River, see annual report for improvement of the Red River of the North, Minnesota and Dakota.

ABSTRACT OF APPROPRIATIONS MADE FOR CONSTRUCTION OF LOCK AND DAM AT GOOSE RAPIDS, ON THE RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA.

By act March 3, 1881	$20,000
By act August 2, 1882	30,000
Total	50,000

Money statement.

July 1, 1884, amount available	$46,947 65
July 1, 1885, amount available	46,947 65
Amount (estimated) required for completion of projected lock and dam, &c., if ordered to be built	224,128 49
Amount that can be profitably expended in fiscal year ending June 30, 1887	100,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

A A 10.

RESERVOIRS AT HEADWATERS OF MISSISSIPPI RIVER.

The object of the reservoirs is to collect surplus water, principally from the precipitation of winter, spring, and early summer, to be systematically released, so as to benefit navigation upon the reaches of the several streams below the dams and also that of the Mississippi below Saint Paul. Alleviation of floods in localities near the proposed reservoirs expected to obtain to some extent, but control of extended floods or freshets covering long reaches not expected.

In order that navigation may be benefited upon the Mississippi above the mouth of the Saint Croix, upon the Saint Croix, the Chippewa, and the navigable reaches of the Wisconsin, the system of dams proposed for each must be carried out, and no benefit of consequence to the Mississippi below Lake Pepin can be predicted unless the entire system is built. The capacities of and supply to the proposed reservoirs are discussed in the several reports upon reservoir surveys of January 15, 1879, December 12, 1879, January 15, 1880, and January 16, 1881. Appendix X, Part II, pages 1457–1459, Report of the Chief of Engineers, 1883, contains a résumé of hydrological observations and conclusions based thereon.

The project for this work may be said to have been adopted in 1880, following an appropriation by Congress for the work, by act approved June 14, 1880.

During the fiscal year three dams were completed, creating reservoirs, as follows:

Name.	Date of completion.	Capacity.	Time required to fill (about).
		Cubic feet:	
Winnebigoshish	August, 1884	40, 000, 000, 000	26 months.
Leech Lake	September, 1884	22, 000, 000, 000	2 years.
Pokegama	October, 1884	3, 000, 000, 000	1 to 2 months.

Those dams are described in the Annual Report for year ending June 30, 1883, pp. 1455–1456, Part II.

Preliminary work upon the Pine River Reservoir Dam, at the outlet of Cross Lake, Minnesota, commenced early in 1884. Operations were much delayed, however, until January last, pending settlement of damages to adjoining lands expected from operation of the dam. The commissioners appointed by the United States district court for the district of Minnesota to condemn the lands rendered their report under date of December 18, 1884, and the amount of their award was paid to the clerk of the court January 23, 1885. This dam is to be 17½ feet high, of timber crib-work, and is more than half completed. As in the case of the other dams, the materials used are those furnished by the country immediately adjoining. The foundations are solidly built, in order that the superstructures may eventually be replaced by masonry-work, should such be considered desirable.

The work upon all the dams has been prosecuted by day labor.

During the season of 1884, the completed reservoir dams were operated more or less in the interest of navigation of the river between Aitken and Grand Rapids, the lateness of their completion precluding any more extended test. During the past winter the low-water discharge was allowed to flow. About the 1st of April the flow was reduced, in order to collect water, navigation not opening until about May 1, and the river below the dams receiving at the same time the supply from April rains. During May water was liberated in sufficient quantities for purposes of navigation below the dams, and during June a liberal supply, in excess of the usual natural discharge, was maintained. It was expected to commence July 1 to increase the discharge to 3,000 to 3,500 cubic feet per second, and to maintanin that discharge until about the 10th of September; but an examination of the river towards the latter part of June showing a plentiful supply of water at and below Aitken, it was deemed best to reduce the discharge from the reservoirs, providing, however, for the needs of navigation on the river below them, and to defer further test until later in the summer.

The three completed dams had impounded by the close of the fiscal year, over and above what was allowed to flow during the fall and winter months, and during March, April, May, and June, 24,000,000,000 cubic feet of water, a quantity which equaled expectation for that time. This result having been achieved once can be achieved again. But, so far as effects upon the channel are concerned from the discharge of the impounded water, it can only be said that the public must not expect from three reservoirs the same results as from the entire number contemplated.

The system as originally reported upon provided for forty-one reservoir dams, in Minnesota and Wisconsin, at an estimated first cost (omitting that of land, &c., damages, an item that could not be approximated to in dollars and cents) of $1,809,083.50.

The reservoirs have been ordered by Congress in the interest of river navigation, and they should not be diverted from that purpose. Some action of Congress bearing upon the full control of the water for navigation will undoubtedly become necessary at an early day. The drainage area tributary to the Mississippi River at the Falls of Saint Anthony is about 20,000 square miles, the river furnishing the means of floating hundreds of millions of feet B. M. of logs to market. For driving their logs the lumbermen construct dams upon the tributaries of the Mississippi in order to accumulate water for flushing. Some of these dams are permanent structures, others are temporary. Their exact number is not known, but about twenty of various sizes were reported this spring, and that number was stated as being far below the actual number. One of the dams impounds enough water at times to represent a discharge of 800 to 1,000 cubic feet of water per second for many days. Other dams have equal or greater effect. The water is impounded and released at the will of the operators, without system other than to get the best results for their own drives of logs.

Amount expended since the project was adopted, including cost of preliminaries, $503,776.23.*

The balance from appropriations available July 1, 1885, will be applied towards completion of the Pine River Reservoir Dam and dikes, to the maintenance of existing works, and care of machinery and floating property.

The sum of $140,000, in addition to the amount already appropriated, can be expended during the fiscal year ending June 30, 1887, in continuing work upon the system at the headwaters of the Mississippi, viz, in work upon the proposed dam at Gull River, increasing the lift for the Pokegama Reservoir (that being found practicable, and much less expensive than constructing a dam below the Vermillion River), constructing telegraph lines, and in incidental repairs to the completed dams.

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* In this amount is not included the sum of $15,466.90, award to Indians for damages.

The annual cost of operating and guarding the three completed dams, and the one whose completion is expected during the fiscal year 1886, is placed at $10,000, and this estimate is submitted for the fiscal year ending June 30, 1887, in addition to that of $140,000 submitted for continuing construction work.

The work upon the dams during the past fiscal year has been in local charge of Assistant Engineer Archibald Johnson, assisted by A. O. Powell and John Cullen, assistant engineers, all of whom are deserving of much credit for the faithfulness and zeal with which they have discharged their duties.

Mr. F. T. Hampton, principal assistant, also rendered valuable services in connection with these works, as well as upon others.

Amounts appropriated to date are:

Act approved June 14, 1880	$75,000
Act approved March 3, 1881	150,000
Act passed August 2, 1882	300,000
Act approved July 5, 1884	60,000
Total	585,000

Estimated cost of the system (omitting that of land, &c., damages)	$1,809,083 50
Remaining to be appropriated	1,224,083 50
Allotment per letter from Office Chief of Engineers, November 9, 1881	1,572 15
Allotment per letter from Office Chief of Engineers, January 20, 1882	176 00
Award to Indians for damages in connection with the building of Lake Winnebigoshish Dam, letter from Office Chief of Engineers November 8, 1881	8,393 30
Award to Indians for damages in connection with the building of Leech Lake Dam, letter from Office Chief of Engineers, January 20, 1882	7,073 60
Allotted for meteorological observations, borings, examinations, &c., letter from Office Chief of Engineers, May 27, 1881	7,500 00

Money statement.

July 1, 1884, amount available		$106,632 62
Amount appropriated by act approved July 5, 1884		60,000 00
		166,632 62
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$76,717 72	
July 1, 1885, outstanding liabilities	8,691 13	
		85,408 85
July 1, 1885, amount available		*81,223 77
Amount (estimated) required for completion of existing project		1,224,083 50
Amount that can be profitably expended in fiscal year ending June 30, 1887		150,000 00
To be expended in construction	$140,000 00	
To be expended in operating dams	10,000 00	
		150,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

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* If the awards to Indians ($15,466.90) for damages have been, or are to be, paid from appropriation "Reservoirs at headwaters of Mississippi River," this amount will reduce to $65,756.87.

A A II.

SURVEYS FOR RESERVOIRS AT THE SOURCES OF THE MISSISSIPPI, SAINT CROIX, CHIPPEWA, AND WISCONSIN RIVERS.

If the reservoir work now begun in Minnesota at the headwaters of the Mississippi River is to extend to the Saint Croix, Chippewa, and Wisconsin rivers, it will be necessary, in order to meet questions constantly arising, as well as to be enabled to make close estimates of cost of dams, flowage, &c., to continue hydrological observations, make borings at proposed dam-sites, recontour some of the sites, and work up the maps, drawings, and estimates.

The funds available for these surveys in 1878 and 1879 were not sufficient for thorough examination of all of the region with reference to flowage, so that in estimating areas of land liable to overflow from creation of reservoirs large margins were necessarily taken on the side of safety. The estimated cost of such examinations as are necessary for one year is $50,000.

There having been no appropriation for such work during the past fiscal year, nothing was done under this head.

Money statement.

Amount that can be profitably expended in fiscal year ending June 30, 1887	$50,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

APPENDIX BB.

IMPROVEMENT OF TENNESSEE AND CUMBERLAND RIVERS, AND OF CERTAIN RIVERS IN EASTERN TENNESSEE, GEORGIA, AND KENTUCKY.

REPORT OF MAJOR WILLIAM R. KING, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Tennessee River.
2. Cumberland River.
3. Hiawassee River.
4. French Broad River, Tennessee.
5. Clinch River, Tennessee.
6. Duck River, Tennessee.
7. Caney Fork River, Tennessee.
8. Little Tennessee River, Tennessee.
9. South Fork Cumberland River, Kentucky.

EXAMINATIONS AND SURVEYS.

10. Elk River, Tennessee.
11. Little River, Kentucky.
12. Condition of the Cumberland River above the mouth of the Jellico, in Kent.
13. Holston River, Tennessee.
14. Extension of the survey of Caney Fork River to Frank's Ferry, Tennessee.

UNITED STATES ENGINEER OFFICE,
Chattanooga, Tenn., July 30, 1885.

GENERAL: I have the honor to submit herewith annual report on the works under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

W. R. KING
Major of Engineers.

CHIEF OF ENGINEERS, U. S. A.

B B 1.

IMPROVEMENT OF TENNESSEE RIVER.

I.—ABOVE CHATTANOOGA.

From Chattanooga to Knoxville, a distance of 189 miles, the Tennessee River is navigable during the greater part of the year, and the object of the present plan of improvement was to remove obstructions and deepen the channel at shoal places, so as to obtain a depth of at least 3 feet at low water.

Examinations made in 1830 and 1872 show that by the removal of twenty-nine obstructions a channel could be secured that would answer all the purposes of navigation.

The obstructions consist chiefly of reefs of rock, with occasional shoals of sand and gravel, and the method of improvement consists in blasting a channel through the reefs, and building stone wing-dams to contract the channel and cause it to scour deeper or to become deeper by the additional volume of water thrown into it.

Nearly all of these obstructions have been more or less improved; many of them entirely removed, and others reduced to secondary importance as obstructions.

The regimen of the river is practically permanent, but little change having occurred in the past fifty years, and as the rock excavations, stone dams, &c., are but little affected by the elements, there being no ice to contend with, the improvement once made is practically permanent. Where any damage has occurred to the dams it has generally been traced to causes which can be avoided in future, or to the wanton acts of parties who made gaps in some of the larger dams to shorten the distance over which they were moving boats.

The annual appropriations for several years have been so small that but little work could be done, and the cost of what was done has, for the same reason, been greater than it should have been.

Active operations were resumed at Chota Shoals, a few miles below Knoxville, soon after the appropriation of July 5, 1884, became available, and continued at these shoals, William's Island Shoals, Lyon's Shoals, Knoxville, and Baker's Shoals until the funds were practically exhausted, about October 15, 1884.

The following are the quantities of work done during the working season, viz:

	Cubic yards.
Solid rock blasted from channel	195
Bowlders and loose rock from channel	330
Gravel from channel	1,261
Rock placed in riprap dams	798

	Number.
Snags removed from channel	19
Overhanging trees cut	15

The work was continued under the local charge of Mr. R. R. Thacher, superintendent, and was carried on by hired labor.

Nine steamers, having a tonnage of from 100 to 200 tons each, navigate the river between Knoxville and Chattanooga, carrying large quantities of coal, iron ore, limestone—for iron smelting and building—grain, lumber, logs, and miscellaneous freight.

The following report of trade is made by merchants as a part of the commerce of this section of the river:

Iron ore	tons	68,990
Limestone	do	20,000
Grain	bushels	345,000
Wood	cords	2,500
Tan-bark	do	500
Coal	bushels	125,000
Logs	feet B. M.	14,300,000
Miscellaneous merchandise	tons	20,800
The estimate for improving the Tennessee River above Chattanooga		$300,000 00
Amount appropriated		$218,500 00
Amount expended		$218,350 36

Money statement.

July 1, 1884, amount available		$91 55
Amount appropriated by act approved July 5, 1884		3,000 00
		3,091 55
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,894 80	
July 1, 1885, outstanding liabilities	47 11	
		2,941 91
July 1, 1885, amount available		149 64
Amount (estimated) required for completion of existing project		81,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

II.—BELOW CHATTANOOGA.

This portion of the Tennessee River from Chattanooga to Paducah, 456 miles in length, is now navigable, excepting at the Muscle Shoals, where about 23 miles of obstructions are in process of removal. The completion of this work will connect 367 miles of navigable water in the Tennessee above Muscle Shoals (besides hundreds of miles in its navigable tributaries), with 252 miles of river below Muscle Shoals, and thence with the entire Mississippi system.

The following extracts from former annual reports give historical facts relating to this improvement and its present condition:

> As early as 1824 Mr. Calhoun, then Secretary of War, mentioned the canal around Muscle Shoals as *third* in rank among the proposed improvements of national importance. In 1828 surveys were made with a view to building a canal around the Muscle Shoals, and Congress donated 400,000 acres of land to the State of Alabama for building it, but the canal was never properly completed and went into disuse soon after it was opened.
>
> In 1867 an examination of the river from Chattanooga to Paducah was made, and in 1872 an instrumental survey of the Muscle Shoals was completed, upon which the present project for the improvement was based, modified, however, by a resurvey of the Elk River Division in 1877.
>
> The existing project consists in enlarging and rebuilding the old canal, 14¼ miles long, around Big Muscle Shoals; extending the improvement around the Elk River Shoals, about 8 miles, and Little Muscle Shoals, 5 miles long, and in removing a number of minor obstructions in the navigable portions of the river, both above and below these great obstructions. For this purpose the estimates were $4,133,000, and with annual appropriations of even one-half of the amounts of the estimates the river would now be navigable, and the commerce of North Alabama and East Tennessee would be joined to that of the Mississippi Valley.
>
> The appropriations have, however, been less than one third of what could have been profitably expended, and the period of completion has consequently been delayed for several years.
>
> The entire chain of obstructions, from deep water at Florence to deep water near Brown's Ferry, is 36 miles long, of which 8 miles require no improvement, and of the balance 16 miles are overcome by canal alongside the river, and 12 miles have been improved by building wing-dams and heavy retaining-walls of stone and by blasting a channel from the solid rock of the river-bed.
>
> This last operation, which is practically completed, was done by means of temporary dams, which were so located as to divert the river from the channel to be worked in, and by coffer-dams, which inclosed successive portions of the river bed, so that they could be pumped out, and the rock thus exposed was blasted out with nearly the same facility as if it had been upon dry land. In this manner about 2¼ miles of channel were blasted out, involving the removal of over 100,000 cubic yards of rock, the improved channel thus formed being smooth and uniform in cross-section 110 to 120 feet wide and 3 feet deep at extreme low water. This work required over 4,500 linear feet of temporary dam and 14,000 feet of coffer-dam.

> The permanent stone dams completed aggregate about 3 miles in length, and contain over 80,000 cubic yards of stone. With some extensions and additions to these, which can be made at almost any stage of the river, but which will not be absolutely needed excepting during the low-water season, the 12 miles of open channel improvement will be completed.
>
> The 16 miles of canal is also well advanced towards completion, and was never in better condition for rapid and economical work than at present. * * *
>
> The canal consists of 14½ miles of old canal, which is being rebuilt, and 1½ miles of new canal on the Elk River Division. The latter requires two locks, one having a 12-foot lift and the other from 5 to 10 feet, according to the stage of water in the river.

The masonry of one of these locks is completed, and is ready for the gates; the foundation pit of the other has been excavated and the masonry is being laid.

Twenty-five acres of heavy timber have been cleared from the land upon which the canal is located, and several acres of drift-wood, snags, saw-logs, &c., have been removed from that part of the river to be used as a boating channel.

On the old canal work is still further advanced. The entire length of the canal has been cleared of the heavy timber which had grown up since the old canal was abandoned, and about nine-tenths of the canal trunk has been enlarged, deepened, and straightened, these operations requiring the removal of 678,337 cubic yards of earth and 91,358 cubic yards of solid rock. The upper end of the canal has been extended through solid rock out to the deep water in the river by means of coffer-dams, and a large embankment of excavated rock has been extended some 800 feet into the river to form a safe entrance to the canal.

The seventeen old locks, which were only 32 feet wide and 118 feet long, have been replaced by nine new locks, 60 feet wide and 300 feet between gates. These locks have a greater aggregate lift than the original locks, namely, 84 feet normal lift and an extreme lift of 94 feet The entire masonry of these nine locks is completed and they are ready for the gates, which are in course of construction, and are being placed in position as rapidly as possible. Twelve of these gates have been built at Chattanooga during the year and shipped to the work. At the present date both the upper and lower gates of Lock No. 1 are completed and in position, and the heel posts of the lower gates are fitted to the hollow quoins; the upper gates of Lock No. 3 are completed and in position. None of the gates are as yet anchored to the masonry.

The piers and abutments of the Shoal Creek Aqueduct, twenty-seven in number, are completed. They are each 75 feet long and average 11 feet in height. During the year a permanent bridge was built upon these piers. This bridge carries a railroad track, which is used for construction purposes, and is eventually to be used in operating the canal. The iron beams for the trunk of the aqueduct are on hand; they are of the I pattern, 17¾ inches deep, and average 32 feet in length; their total weight is about 600 tons. As beams of sufficient size are not made in this country, they were procured in Belgium.

At Bluewater Creek a permanent bridge is also built, having seven piers and two abutments. All the masonry has cut beds and joints, and was laid in hydraulic cement. These piers are grooved at the sides to receive the sections of a permanent dam to be thrown across the creek when the canal is ready for filling. This bridge also carries a railroad track.

The piers and abutments of a similar bridge are in course of construction at Six Mile Creek; and at Second Creek abutments of a similar description, and for the same purpose, have been completed. At Douglass

Branch, a stone waste weir, 60 feet long, and carrying also a railroad bridge, has been built.

The construction railroad now extends the entire length of the canal, and is in good working order.

During the year a heavy embankment, above Lock No. 7, has been completed, excepting a short section near Six Mile Creek, and some heavy masonry, in the shape of wing-walls at the aqueduct abutments, retaining walls near Locks Nos. 7 and 9.

Muscle Shoals Division.—During the year the work on this division has been carried on under the local charge of Assistant Engineer Robert Hooke, with an average force of 184 men.

The following table shows the principal items of work done during the year, the total quantities of work done up to the 30th of June, 1884, and the total quantities to June 30, 1885:

Items of work done.	1875–1884.	1884–1885.	Total, 1875–1885.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*
Earth excavation, including sand and gravel	713,345	52,314	765,659
Solid-rock excavation	117,765	3,358	121,123
Loose rock and hard pan, including old locks and slope wall, removed	41,769	3,985	45,754
Embankment	361,933	82,600	444,533
Stone cut, cut stone	10,581	890.8	11,471.8
Stone cut, rock face	3,103	212.4	3,315.4
Masonry laid:			
Cut stone	13,018	106.2	13,124.2
Rock face	9,752	73.5	9,825.5
Rubble	28,426	591.8	29,017.8
Dry rubble, including slope wall	4,783	4,286 2	9,069.2
Stone quarried	26,236	2,791	29,027
Stripping quarries	4,670	5,117	9,787
Riprap, in dams and embankments	30,322	370	30,692

In addition to the above, much work of a miscellaneous character has been done in repairing and rebuilding railroad track and trestle work, machinery, buildings, boats, &c., boating stone, iron, and other building materials and supplies.

The percentage of the entire work completed on June 30, 1884	.75
And during the fiscal year 1884 and 1885	.06
Total percentage done up to June 30, 1885	.81

Elk River Division.—In charge of W. A. Toms, assistant engineer, with an average force of ninety men.

The following are the principal items of work done:

Earth excavation	cubic yards	23,941
Solid-rock excavation	do	3,073
Embankment	do	6,161
Masonry laid:		
Cut stone	do	829
Rock face	do	798
Rubble	do	3,313
Dry rubble	do	1,125
Stone quarried		4,888
Stripping quarries (used as lining to permanent dam)	cubic yards	4,618
Crib-dam	linear feet	735
Stone cut:		
Hollow quoins	number	41
Cut stone	cubic yards	118.5
Bedded first course	linear feet	178
Stone in dams	cubic yards	3,266

Miscellaneous—Large quantities of cement, iron, iron lock-gates, tools, provisions, and supplies were boated from Decatur to Milton's Bluff and thence to Lock No 1.

The amount available, and that herein estimated for, can be applied to the completion of the work at Muscle Shoals and to the improvement of minor obstructions between Chattanooga and Paducah, as provided for in the approved project.

It is especially desirable at this time that a liberal appropriation be made, so that the work already done can be utilized, as I confidently believe it can be by the opening of the Muscle Shoals Canal. Even if the latter, which is now an absolute barrier to navigation, is not absolutely finished, it can be put in navigable condition, and, with a sufficient appropriation, work at several of the smaller obstructions can be carried on advantageously in connection with the main work.

Five steamboats navigate the river between Chattanooga and Decatur, and I have not been able to obtain an estimate of the freight carried. Two of these boats run regularly during the greater part of the year, and one runs to Milton's Bluff, thus utilizing 5 miles of new channel on the Elk River Shoals Division.

The Evansville, Paducah and Tennessee River Packet Company runs several steamboats on the river below Florence, Ala., but no commercial statistics have been received for the year just ended.

Estimate of cost of improving Tennessee River:

River below Chattanooga	$4,133,000 00
Amount appropriated	2,695,500 00
Amount expended	2,574,993 72

Money statement.

Amount appropriated by act approved July 5, 1884		$350,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$215,372 67	
July 1, 1885, outstanding liabilities	14,121 05	
		229,493 72
July 1, 1885, amount available		120,506 28
Amount (estimated) required for completion of existing project		1,437,500 00
Amount that can be profitably exdended in fiscal year ending June 30, 1887		550,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

DESCRIPTION OF APPLIANCES USED ON THIS WORK.

SHEET I.—STEAM-EXCAVATOR.

This machine was designed for use at Elk River Shoals, where, in excavating the canal 100 feet wide and but a few feet below the natural surface, ordinary scrapers could be used to advantage, and it was thought that steam-power could be economically substituted for animal power.

The driving-machine consists of a small steam hoisting-engine (not shown in the drawing), placed upon a car and connected by a belt and gearing with the chain barrels, around which passes an endless chain for transmitting the power of the motor to the scrapers. The car is placed upon a movable track, which can be shifted along as the work progresses, the car itself being moved along a few feet at a time and blocked firmly, so as not to be pulled over by a strain upon the chain.

The chain passes around pulleys at the opposite side of the canal, these pulleys being secured to a car like that already described, but loaded with stone to give it the requisite stability.

The main chain is about 250 feet long, and made of ⅝-inch iron. The branch chains, connecting with the scrapers and plow, are about 15 feet long, and are made of ⅝-inch iron.

The chain-barrels are provided with flanges and zigzag lugs to prevent slipping, and their axles are inclined to the front in such a way that the chain, although sagging very considerably in the middle, will draw nearly parallel with the plane of the grooves. This allows the main chain to keep the grooves, while the branch chains, when they reach the pulleys, draw at such an oblique angle as to fall below the flanges, and thus avoid winding around the wheels.

Some trouble was experienced in the trials of this machine from the tendency of the main chains to twist over and over and wind up the branch chains so that they would not pass freely around the chain-barrels; but this was overcome by placing a swivel at the junction of the branches with the main chain.

The failure of the appropriation bill made it impracticable to use this machine on the work during the past season, but the experimental trials seem to indicate that it is perfectly practicable, and with one plow and five or six scrapers it is probable that a large amount of work can be done with it in localities suited to its operations.

It is expected that two or three men can fill the scrapers as they come along, and others can dump them when they reach the embankment.

SHEET II.—PORTABLE DRILLS FOR SHOAL CREEK AQUEDUCT.

In riveting the bottom plates to the girders of the Shoal Creek Aqueduct a very large number of holes will have to be drilled, and for accurate work it is desirable that they should be drilled in position. To facilitate this operation, two batteries of five drills each have been made, as shown by the engraving. The bed-plate slides along the upper flange of the girder, and the drills are driven by a small steam-engine that can be moved along on a light car and kept opposite the pulleys, to which the engine will be attached by a 3-inch belt.

The drills can be fed together or separately, and in drilling holes less than 4 inches apart they will be adjusted so as to drill alternate holes in succession, for which purpose the positions of the drills on the bed-plate can be changed as may be required.

SHEET III.—ROCK-DRILL FRAME.

This machine was intended for mounting an ordinary steam-drill so as to drill deep holes in the masonry, and consists of a light iron frame of angle-iron, like the guides of an ordinary pile-driver, mounted on two wheels for convenience in moving from place to place.

The frame, when in use, rests on the three large set-screws, and the weight of the drill and cylinder is counterpoised, so that by loosening the four hand nuts, shown on the front of the frame, the cylinder can be raised or lowered at pleasure. This allows a long drill to be used conveniently. The whole affair is steady and compact, and true cylindrical holes are drilled rapidly and easily.

SHEET IV.—CULVERT-VALVE FOR CANAL LOCKS.

This valve consists of a wooden shield to cover the opening in the masonry, but moving upon four cast-iron wheels, so as to avoid the excessive friction encountered when ordinary slide-gates are operated under heavy pressure. In order that the gate may move freely, it has about a quarter of an inch clearance all around, excepting that thin plates of steel cover the openings and slide under the slight pressure due to their small surface.

The main fluid pressure is carried by the wheels, and the valve is operated by man-power applied to the hand-wheel, shown at the top of the lock-wall, which turns an endless screw working in a rack bolted to the back of the valve.

From such experiments as could be made with two of these valves, already built, there is good reason to expect that they will answer the purpose in all respects, and they cost only about $95 each when ready to put in place, or one-tenth part of what I understand is the cost of iron "stoney" valves for the same sized openings. They can be taken out and replaced readily, and there appears to be no trouble in making and keeping the joints tight enough for all practical purposes, while the combination of timber and iron is so nearly of the same specific gravity as water that no counterpoise is needed.

Some parts of the timber will doubtless have to be replaced every eight or ten years, but this can be easily done, and the greater part of the wood-work will be entirely under water, and will last nearly as long as iron would under the same conditions.

SHEET V.—SUSPENDING FRAME FOR LOCK GATES.

This drawing shows the general arrangement for suspending the iron lock-gates. In order to bring the point of suspension directly over the fixed axis of the heel-post, a cast-iron frame, shaped like the letter A, is placed upon the lock-wall and firmly secured in its position by bolting to the coping and by two 2½-inch rods securely anchored to the bed-rock and to the masonry. A rod of like diameter also connects the top of the A-frame with the top of the gate, the upper end of this last rod being attached to the top of a steel pintle, 5½ inches in diameter and 5 feet long, which turns freely in the top of the frame, and rests upon a hardened steel step, which takes the entire vertical strain. It is also possible, if it should be found desirable to do so, to connect the pintle with the top of the heel-post by means of a turn-buckle so arranged that any required portion of the weight that ordinarily comes upon the pivot at the bottom of the heel-post may be transferred to the pintle above. The advantage of this would be that the weight would then come upon a small polished steel bearing, always accessible, and which could be oiled as often as desired, instead of coming upon the large chilled-iron pivot, which, being always under water, would be liable to rust and grit from the muddy water.

The top of the heel-post is secured by a collar of 1½ by 6 inches wrought iron, bolted and keyed to a strong cast-iron plate, which is strapped and bolted firmly by nine 1⅝-inch bolts, extending 5 feet deep into the masonry. In order to divide the weight of the gate equitably between these two independent sets of supports, either of which could hold the entire weight by itself, a strong spiral spring is inserted in the yoke which connects the top of the pintle with the rod attached to the gate.

The advantage expected from this arrangement is that the entire system is accessible and adjustable, that the parts are strong and simple, and friction will be reduced to a mere fraction of what is encountered in the track and roller system or in most other forms of suspension.

SHEET VI.—SHOAL CREEK AQUEDUCT.

This aqueduct consists of twenty-six spans, about 30 feet clear space, giving an entire length of 858 feet, with a width of 60 feet at the water line, a depth of 5 feet in the clear, and 6½ feet to bottom of canal-trunk.

The piers and abutments, which are of stone, have been built for some time, and the superstructure is now in progress.

The girders are 17¾ inches deep, excepting the top line, which are 15 inches, and it required five hundred and forty-six of the former and fifty-two of the latter. The plates are to be ¼-inch steel, in single lengths of over 30 feet, and from 3 to 5 feet in width.

The bottom plates are curved slightly upward along the edges to fit the flanges of the girders, and rest for about half of their widths upon the top of the walls.

It is proposed to connect the spans in pairs, so that the expansion will take place only on alternate piers, and thus allow a rigid connection at every other pier, so as to prevent the "creeping" of the iron-work on the masonry. The amount of expansion will be very small—only about an eighth of an inch to the span—and in a direction across the aqueduct it will be allowed for by a slight change in the curvature of the plates, as already described.

The aqueduct piers carry also a railway bridge of trussed girders, as shown in the drawing. The trusses are formed of 9-inch I beams and 1½-inch suspension rods secured to the ends of the beams by flat shoes riveted to the bottom flange, the struts being of cast-iron and triangular in form, so as to give a broad bearing at the top where they are secured to the beams.

SHEET VII.—STEAMER ELK.

This little steam-scow is the type of a very useful and economical kind of light-draught tow-boat, several of which have been built and employed on the river improvements in this district.

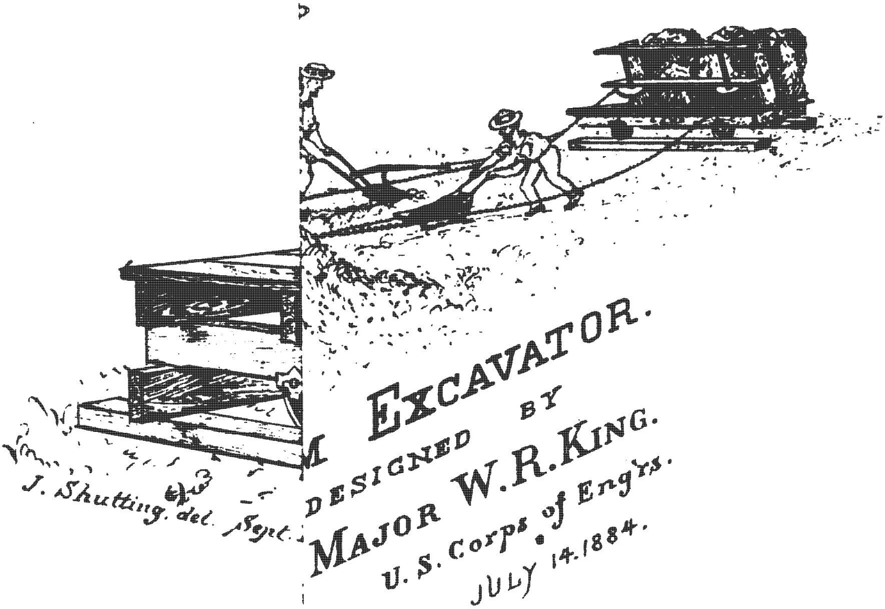
The dimensions of the boat and machinery are given on the drawing, and I believe her performance in towing barges will equal any light-draught steamer of her size and cost in these waters.

The boiler is of the ordinary locomotive pattern, and the engine is a Lidgerwood hoisting engine, the shaft of the boat taking the place of the axis of the winding-drum, and a light frame of angle-iron and wood being substituted for the usual cast-iron bed-plate.

The engine makes about four and one-half revolutions to one of the main shaft, which gives a piston speed equal to that of direct connected engines with 45 inches stroke.

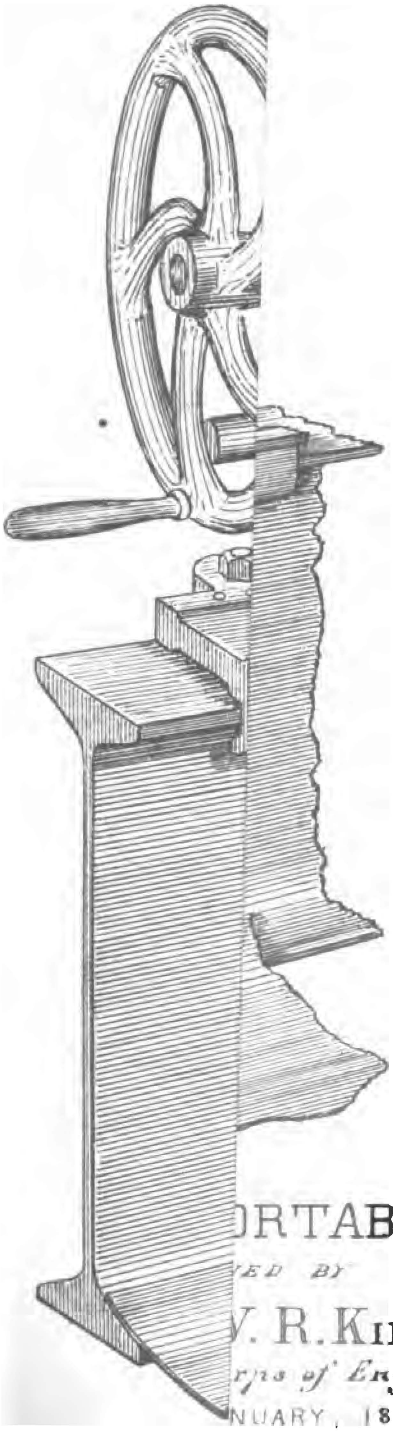
The entire cost of the boat, including engine and boiler, in running order, was $2,000, but the boiler was not bought for this special use, and in other cases the engines also have been "picked up" from the stock on hand, bought for other purposes but no longer needed.

SHEET I.


M EXCAVATOR.
DESIGNED BY
MAJOR W.R.KING.
U.S. Corps of Engrs.
JULY 14.1884.
J. Shutting. del. Sept.

H Ex1 pt2 v2 49 1

SHEET II.



ORTABLE DRILL.

VED BY

V. R. KING.

rps of Engineers.

NUARY, 1885.

H Ex1 pt2 v2 49 1

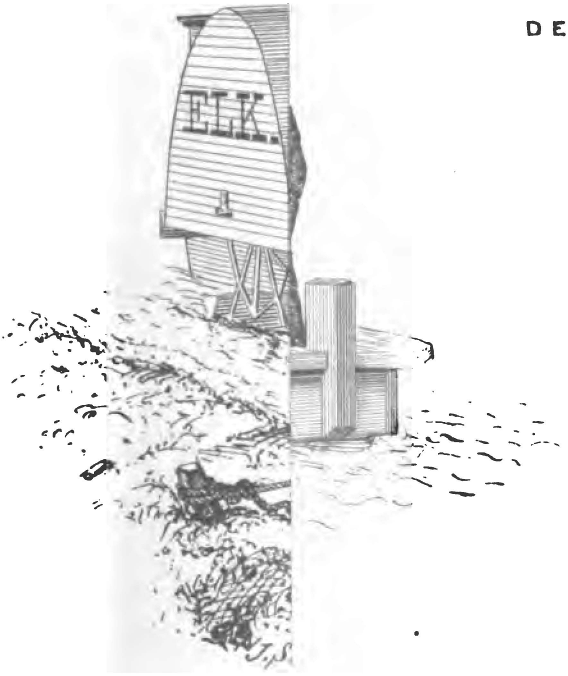
SHEET VII.

STEAMER "ELK".

DESIGNED BY

ASST. ENGRS W. A. TOMS,
J. H. MAYHEW,
et als.

DEC. 1884.



Hull.

Fire Length over all 60'. Beam 11'9".
36" Diam. Dpth of Hold 3'. Draught (light) 12".
2¼" Diam. Diam. of Wheel 9'. Buckets 12"×42".

SHEET VIII.

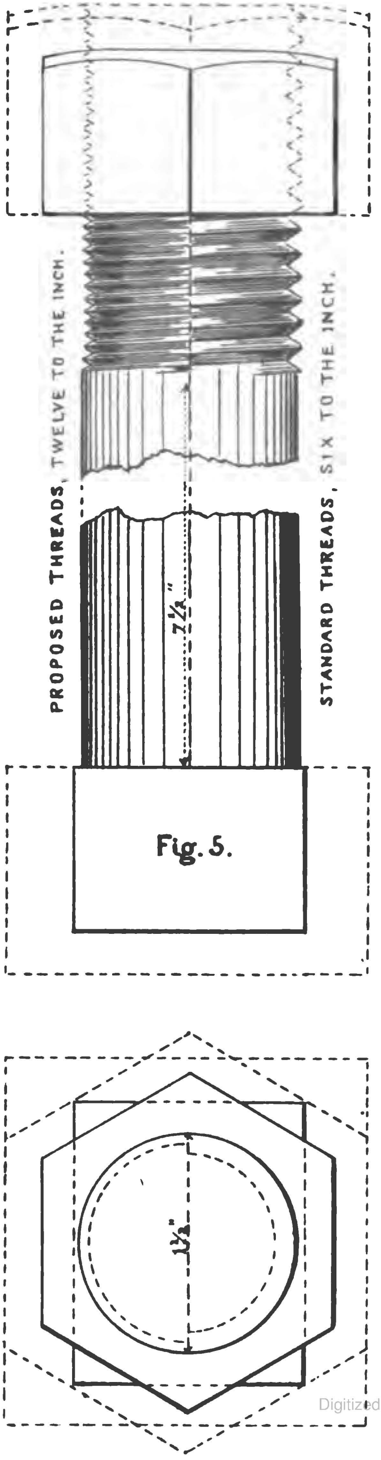
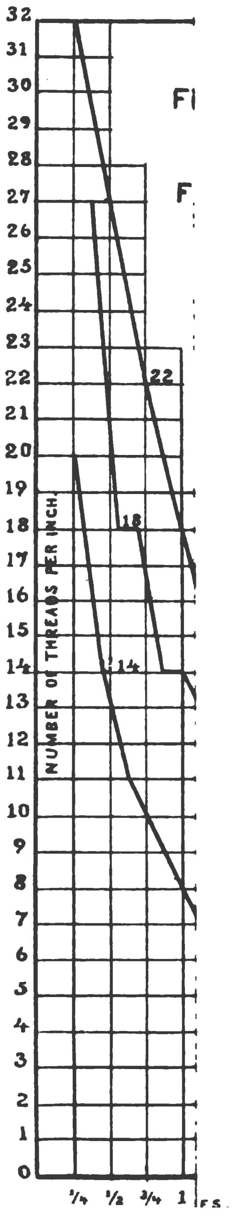

PROPOSED THREADS, TWELVE TO THE INCH.
STANDARD THREADS, SIX TO THE INCH.
7½"
1½"

Fig. 5.

DOTTED LINES SHOW "STANDARD", AND FULL LINES PROPOSED SIZES OF HEAD AND NUT.

EXPERI



SHEET VIII.—EXPERIMENTS WITH SCREW-THREADS AND NUTS.

In my last report I gave an account of some experiments showing that the standard sizes of screw-threads are much too coarse, and that there is a great waste of metal in bolt heads and nuts. These results showed that for a 1¼-inch bolt twelve threads to the inch gave nearly 20 per cent. greater strength than six threads, the standard number, and I stated that "it is quite probable that even finer threads than those tested, say sixteen or eighteen to the inch, would give better results."

As it requires over 4,000 of these bolts for the lock-gates, I have recently tested the matter still further, and find as predicted that 18 threads to the inch gives decidedly greater strength than 12 threads, and for some purposes it might be desirable to go to that extent in the reform, but other considerations besides strength will probably limit the number to about double the number required by the present tables.

In these latest tests three pairs of bolts were made, one pair having 6 threads one 12 threads, and one pair 18 threads to the inch, but in all other respects the bolts were as nearly alike as it was possible to make them. They were turned from bar-iron, 1¾ by 2 inches square (see Fig. 5), so that no forging was required.

The results were still more favorable for the fine thread, for when broken in a hydrostatic press not a single nut showed signs of weakness, and the bolts with 18 threads to the inch showed unmistakably that they were stronger than the others, although they finally yielded by pulling out of the nut—not by stripping the threads, as we generally understand it, but by actually drawing down the size of the bolt until the greater part of the threads were disengaged, as can be seen from the specimens.

In Fig. 4 I have plotted the strains and corresponding stretch of the 6 bolts, the dotted line showing the probable relation between the stretch and strain upon each bolt while under tension, and for comparison therewith a diagram enlarged from an autographic sheet (similar to an indicator diagram), taken in 1870, which is thought to be the first attempt ever made to get a continuous record of the behavior of iron under varying strains.

	Pounds.
The standard bolts broke at an average strain of	76,655
Those with 12 threads at	92,991
Those with 18 threads yielded at	94,248

It was noticed that the latter were just on the point of breaking when the nut pulled off.

Mean results.

Items.	6 threads.	12 threads.	18 threads.
Relative tensile strength	1.	1.21	1.23
Stretch	.025	.06	.08
Relative work	.025	.0726	.0984
Or	1.	2.9	4.

In Fig. 3 I have suggested a new standard for screw-threads in accordance with the indications of these experiments. That it would be a great improvement on the present standard I have no doubt, and I have endeavored to fix upon the simplest numbers for each size of bolt that will give about double the present standard number of threads to the inch, and avoid fractional numbers as far as possible.

Figs. 1 and 2 (from my report of 1883) are simply given to show the important advantage of having the strength of all parts of a structure proportional to the strains they are to bear. As the strength of a beam can be more than doubled by cutting away surplus material, as shown by these experiments, so bolts, nuts, and screw-threads can be made lighter, stronger, and cheaper by simply adopting proper proportions, instead of having one part two or three times stronger than another, as at present practiced.

B B 2.

IMPROVEMENT OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY.

The States of Tennessee and Kentucky made appropriations for the survey and improvement of the Cumberland River as early as 1830, and in 1846 a charter was granted by the former State to build locks and dams upon the river below Nashville.

In 1870 Congress authorized a survey of the Cumberland, and in 1875 a resurvey of that portion embracing Smith's Shoals. The present plan of improvement was based upon these surveys. In 1879 a survey was made of the Falls of the Cumberland, and in 1880 a reconnaissance of the Upper Cumberland. Another survey of the Cumberland River at Smith's Shoals, Kentucky, was made in 1881, to ascertain the practicability and cost of a canal, with locks and dams, from the head to the foot of said shoals, and a survey in 1883 from Point Burnside to Nashville, with a view to placing locks and dams on the Cumberland River between these points.

The Cumberland River has been divided into a number of different sections in the various river and harbor acts, and these sections will be considered in their order.

The obstructions to be overcome in the different sections are similar in character, consisting of rock-reefs, gravel-bars, snags, bowlders, and overhanging trees, and on that portion of river above the Jellico mainly of fish-traps and mill-dams.

The method of improvement followed has been to blast a channel through the rock-reefs, remove gravel-bars and bowlders, build riprap-dams where a contraction of the water-way is required to secure additional depth, and to remove snags and overhanging trees.

The Cumberland is navigable for all steamboats which ply upon it for six months in the year from Nashville to the mouth of the river, a distance of 192 miles, from six to eight months for boats drawing 3 feet and less, and the entire year for boats of 16 inches draught. Above Nashville the river is navigable to Point Burnside (the Cincinnati Southern Railway crossing), a distance of 327 miles, from four to six months each year for steamboats drawing 3 feet or less, and from two to three months for larger boats. From Nashville to Burksville, 238 miles above, the river is navigable for steamers of 3 feet draught for from five to seven months, and from three to five months for the larger boats. From Nashville to Carthage, 118 miles above, the river is navigable from six to eight months for steamers of 30 inches draught, and from four to five months for larger boats.

The work done upon the Cumberland, though not yet completed, has already had the effect of extending the duration of navigation both above and below Nashville.

The estimates for the improvement of the Cumberland River have been based on the idea that the appropriations would be made for the entire work in a reasonable time, say four or five years; but in the case of the river below Nashville the annual amounts have been so small that although fifteen years have elapsed since General Weitzel made his estimate, the full amount has not yet been appropriated; and above Nashville only $50,000 have been appropriated for a system of locks and dams estimated to cost over $4,000,000, at which rate it would take eighty years to complete the work. Of course it would be impossible to carry on work with proper economy under such conditions, and I would respectfully urge that Congress may give the subject its due consideration, and if the more radical system of improving this river under the existing projects is decided to be advisable in view of the necessities of commerce, an appropriation of at least one-tenth of the estimate for completing the work may be made.

The shipments made on the Cumberland from July 1, 1884, to June 1, 1885, are as follows:

Articles.		Below Nashville.	Above Nashville.
Iron	tons	12,128	3,029
Grain	bushels	1,098,675	152,781
Tobacco	hogsheads	1,736	2,449
Live stock	head	894	2,756
Coal	bushels	20,302	71,453
Stone	tons	2	24
Spokes and hubs	bundles	3,044	*53
Logs	feet, B. M.	1,140,000	6,686,000
Lumber (in rafts)	do	890,000	705,000
Lumber (on steamers)	do	859,586	3,628,861
Shingles	M	948	....
Bricks	do	180	29
Hay	tons	....	362
Wood (barges)	cords	....	2,000
Fire-bricks, tiling, and clay	tons	....	125
Sand	barges	....	74
Stave-boats (laden)	number	....	5
Miscellaneous merchandise	(estimated) tons	5,000	3,245
Passengers		5,383	9,525

* Tons.

I.—BELOW NASHVILLE.

Active operations were resumed on this section August 7, 1884, and continued until November, when high water caused a suspension until June, 1885, when work was resumed at Line Island, and is now in progress. C. A. Turrill, assistant engineer, is in local charge.

The following is a statement of the work done at the localities named:

At Race Track Shoals and Ingram Shoals a dam was repaired at each obstruction; 236 cubic yards of rock were quarried and put in dams.

At Little River Shoals a dam was extended by adding 314 cubic yards of rock; 4,530 cubic yards of gravel were taken from the channel at Sycamore Bar, Half Pone Bar, Medlock's Bar, Seven Mile Ferry, Palmyra Island, Well's Island, Elk Creek Shoals, Line Island, and Ingram Shoals. Near the mouth of river (Cumberland Island) one brush and stone dam was built; 34 piles were driven, 932 cords of brush and 875 cubic yards of stone were used; 2,595 cubic yards of gravel were also removed at this point.

In addition to this a snag-boat descended the river from Nashville to the mouth of the river, removing 128 snags and 14 cubic yards of rock *en route*.

As a result of the season's work a channel of at least 2 feet at low water, and 80 feet wide, was secured at the Cumberland Island Bar, at the mouth of the river, and a small packet steamer made continuous trips over the bar during the low-water season of 1884.

The amount asked for ($50,000) can be profitably expended in clearing the channel of surface obstructions, in continuing work of improving the most dangerous shoals below Nashville, and in improving the channel from the mouth of the river to deep water in the Ohio by building brush and stone dams, dredging, &c.

The estimates of cost of improving the Cumberland River below Nashville	$348,000 00
Amount appropriated	242,500 00
Amount expended	240,911 23

Money statement.

July 1, 1884, amount available		$61 14
Amount appropriated by act approved July 5, 1884		7,500 00
		7,561 14
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,620 79	
July 1, 1885, outstanding liabilities	351 58	
		5,972 37
July 1, 1885, amount available		1,588 77
Amount (estimated) required for completion of existing project		105,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

II.—ABOVE NASHVILLE, FROM NASHVILLE TO HEAD OF SMITH'S SHOALS.

Work was resumed on this section in August, 1884, as soon as practicable after the funds were made available (act of July 5, 1884), and was continued throughout the remainder of the fiscal year under the local charge of Assistant Engineer C. A. Turrill.

A snag-boat, with a small working party, descended the river from Lower Holliman's Island to Nashville, 144 miles, repairing dams where necessary, and removing minor obstructions between those points.

The following is a statement of the work of this party at the localities named:

Locality.	Dams built.	Dams repaired.	Linear feet dam built.	Rock taken from river.	Gravel excavated.	Rock put in dams.
				Cu. yds.	*Cu. yds.*	*Cu. yds.*
Lower Holliman's Island	1	......	140	300	....	300
Niagara Shoals	1	......	160	....	180	360
Sand Shoals	1	......	70	....	....	192
Whitley's Island Shoals	......	1	......	....	....	145
Belote's Bar	......	1	......	....	....	10
Total	3	2	370	300	180	1,007

General work: Three hundred and forty-one snags removed, fifty-nine overhanging trees cut down, and ten trees topped.

This work was finished in November, when snag boat operations were suspended.

In pursuance of the general plan of improvement it was decided, after making the necessary examinations and local surveys, to begin operations at Upper Nashville Island, and, by means of spur-dams, and excavation, endeavor to obtain a depth of 4 feet throughout the shoal, and to so alter the slope of the river and the slope of the channel as to make the improvement permanent, and at the same time leave favorable conditions for continuing a radical plan of improvement at the next obstruction above.

To attain this object, channel excavation was begun September 30, and continued until stopped by high water. This excavation was confined to blasting out the principal rock reefs, as far as practicable, and the more thorough work, with auxiliary appliances and the aid of coffer or temporary dams, postponed until another season. Quarry work and the construction of riprap wing-dams were carried on with a small force during the winter.

The following quantities of work were done at Upper Nashville Island during the season:

	Cubic yards.
Earth stripped from quarry	416
Rock quarried for riprap	8,812
Riprap dams built (1,955 linear feet)	5,344
Rock excavated from channel	670
Gravel excavated from channel	720
Logs and snags from channel	23

The improvement at this point is about one-half completed. No results can be given until it is finished, and even then, from the nature of the work, it will require time to realize its full benefit.

In addition to this, the following work was done at Waitsborough Shoals, 5 miles below Point Burnside, by a small force in local charge of Assistant Engineer W. C. Crozer, between the 15th of October, 1884, and the 1st of February, 1885.

	Cubic yards
Loose rock excavated from channel	697
Gravel excavated from channel	112
Stone quarried for riprap	1,555
Stripping quarries	118
Riprap dam built	1,543

At Smith's Shoals no work has been done during the year, and it is not thought that anything further will be needed for the present, as coal-boats and rafts can now descend safely on a much lower tide than formerly, and those interested in the navigation of this part of the river are beginning to appreciate the fact and utilize the improvement. These shoals have heretofore constituted a separate section of the river, but are now included in the appropriation and estimates for the section "above Nashville."

The amount available and the appropriation asked for ($400,000) can be profitably expended in operations above Nashville in building locks and dams and in such open channel work as will be needed whether the lock system is carried out or not, the work to be carried on in a tentative manner, so as to ascertain just how far wing and training dams can be use to advantage in place of the lock system.

Estimate for improving the Cumberland River from Nashville to head of Smith's Shoals	$4,077,922 00
Amount appropriated	50,000 00
Amount expended	20,939 65

Money statement.

Amount appropriated by act approved July 5, 1884		$50,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$20,274 01	
July 1, 1885, outstanding liabilities	665 64	
		20,939 65
July 1, 1885, amount available		29,060 35

Amount (estimated) required for completion of existing project	$4,027,922 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	400,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

III.—CUMBERLAND RIVER ABOVE THE MOUTH OF JELLICO, KENTUCKY.

For reasons stated in former reports no work has been done on this section of the river since 1882. It is believed that the charter of the company, which the State of Kentucky authorized to build locks and dams on this part of the river, and take tolls for use of same, has expired by its own limitation, but it is doubtful whether much good could be done with the balance of the appropriation available for the improvement of this section of the river, owing to the existence of eleven mill-dams upon it, and I would therefore respectfully recommend that the balance on hand be applied to the section of the river between the head of Smith's Shoals and Nashville.

Estimate for improving the Cumberland River above mouth of Jellico, Kentucky	$50,000 00
Amount appropriated	15,000 00
Amount expended	9,638 44

Money statement.

July 1, 1884, amount available	$5,361 56
July 1, 1885, amount available	5,361 56

Amount (estimated) required for completion of existing project	35,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

B B 3.

IMPROVEMENT OF HIAWASSEE RIVER, TENNESSEE.

No work has been done upon this river during the fiscal year, nor since active operations were suspended in November, 1882.

No commercial data have been obtained. The following extract from previous annual reports are still applicable:

> The commerce is partly carried on by steamboats from the Tennessee River and partly by flat and keel boats.
>
> The appropriations for this river have been so small for several years past that a considerable portion of them has necessarily been expended in taking care of the plant, and other expenses that are constant, whether much or little be done.
>
> This has made the work actually done cost excessively, and it cannot be otherwise with such small appropriations. With the $2,500 now available, which will be applied to such points as are most in need of improvement, this river will be put in a fair boating condition, and I would therefore respectfully recommend an appropriation of at least $5,000, or that the work be suspended as soon as the funds available are exhausted until Congress deems it advisable to make such an appropriation.
>
> The tools and other property can be removed to the Tennessee River, where a part of them can be used and the balance stored until they are again required for the Hiawassee without expense to the latter.

The estimates of cost of improving Hiawasse River, Tennessee	$36,500 00
Amount appropriated	31,500 00
Amount expended	28,868 47

Money statement.

July 1, 1884, amount available	$131 53
Amount appropriated by act approved July 5, 1884	2,500 00
	2,631 53
July 1, 1885, amount available	2,631 53
Amount (estimated) required for completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

B B 4.

IMPROVEMENT OF FRENCH BROAD RIVER, TENNESSEE.

The French Broad River enters the State of Tennessee at Paint Rock, and after a course of 121 miles empties into the Holston River, 4½ miles above Knoxville.

From the junction of the Nolichucky up to the State line the French Broad is not susceptible of improvement, except by slackwater navigation at enormous cost. After receiving the waters of the Nolichucky its character changes to a broad and beautiful stream, well adapted to navigation.

The present plan of improvement, based upon an examination made in 1876, consists in removing obstructions from the channel, cutting down overhanging trees, and building wing-dams where necessary, so as to permit the passage of boats drawing 2½ feet of water as far up as Leadvale, 90 miles, during the low-water season.

Active operations were resumed October 17, 1884, in local charge of Mr. R. R. Thacher, superintendent, and continued until January 10, 1885, when high water caused a suspension until April 7, 1885, when work was resumed and is now in progress.

During the season work was done at the following localities: Jumping Moses Shoals, Hanging Rock Shoal, Wesley Chute, and Sewee Shoal.

The items of work were as follows:

Rock blasted from channel	cubic yards	164
Gravel excavated	do	569
Bowlders	do	374
Rock quarried for riprap dams	do	795
Rock placed in riprap dams	do	468
Stripping quarries	do	273
Old dam removed	do	42
Snags and logs removed	number	4
Trees cut	do	9

As a result of the season's work the Jumping Moses Shoals and Hanging Rock Shoals, the worst obstructions in the portion of the river under improvement, have been successfully removed. Two steamboats have made continuous trips during the season, and boatmen express themselves as highly pleased.

The funds being nearly exhausted the boats and working force will soon be removed to the Hiawassee River, so as to avoid the expense of organizing a new force and supplying boats and tools for the small amount of work that can be undertaken with the funds available for that stream.

The amount herein estimated for ($25,000) can be profitably expended in continuing the work of removing surface obstructions from the channel and in building wing-dams where necessary, so as to permit the passage of vessels drawing 2½ feet as high as Leadvale during the low-water season.

The original estimate of cost of improving French Broad River from Dandridge to its mouth was	$150,000 00
From Leadvale to the North Carolina State line, no estimate has been made.	
Amount appropriated	22,000 00
Amount expended	21,560 00

Money statement.

Amount appropriated by act approved July 5, 1884		$3,500 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,703 32	
July 1, 1885, outstanding liabilities	356 68	
		3,060 00
July 1, 1885, amount available		440 00

Amount (estimated) required for completion of existing project	128,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	25,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

B B 5.

IMPROVEMENT OF CLINCH RIVER, TENNESSEE.

The Clinch River rises in Virginia, and after a course of about 200 miles in that State enters Tennessee, and, flowing in a general southwesterly direction, empties into the Tennessee River at Kingston, 230 miles from the point where it crosses the State line.

The valley of the Clinch is so isolated from the rest of the world by parallel mountain ranges as to make the river the main highway by which the products of this region find a market. No railroads are accessible excepting the Knoxville and Ohio, which crosses the river at Clinton and leaves the valley at Cane Creek, 7 miles above.

These facts serve to explain why the improvements already made have been so promptly utilized, the rapid increase of commerce, and the anxiety of the people for the early completion of the projected improvements.

It has already been found necessary to make the channel from two to three times the width thought sufficient when the original estimates were made, and this, together with the increased cost due to small and irregular appropriations, renders a revision of these estimates necessary.

It is therefore respectfully recommended that the original estimate for improving the Clinch River, Tennessee, $26,400, be increased to $50,000, which will probably be sufficient for the purpose.

Active operations were resumed in August, 1884, with Assistant Engineer W. G. Sanborn in local charge, and continued until June, 1885, when the work was closed, the appropriation being nearly exhausted.

During the season operations were extended as far up the river as the head of Vansil's Islands.

The projecting portion of Kellar's Bluff and a small tow-head just above were removed, also minor obstructions from the channel at Hurricane Shoals and Gourd Island. Many snags were removed from the lower 125 miles of the river and cut up.

The improvement of the series of shoals known as Hitches Shoals, Bear Wallow Shoals, Bletcher's Shoals, Brushy Bend Shoals, and Cloud's Shoals, was completed in a thorough and substantial manner.

A channel averaging 120 feet wide was blasted through the rock bars, and strong, heavy wing and longitudinal dams so constructed as to confine the water to the channel until the required depth of water was obtained.

Numerous gauges were established and frequent soundings taken to guide and determine the limits of work at each place. Thus all unnecessary work was avoided, and the best results obtained with the least possible expenditure of money.

The improvements thus far have given great satisfaction to all having business upon the river, and they have not hesitated to express not only their approval but also their hope that the entire improvement might soon be completed.

The following are the items of the season's work:

Solid rock excavation	cubic yards..	1,830
Loose rock excavation	do....	861
Sand and gravel excavation	do....	8,785
Rock quarried	do....	1,809
Stone dams built	do....	3,812
Timber cribs for dams	linear feet..	396
Overhanging trees cut	number..	40
Snags removed or cut up	do....	193

The following commercial statistics are taken from the assistant engineer's records of the last ten months of the fiscal year and from information kindly furnished by Messrs. W. H. Brown and G. A. Guenther, of Kingston, Tenn.:

Rafts (containing 154,162 logs=63,731,000 feet B. M., 50,000 spokes, and 10,000 bushels of grain)	number..	2,216
Flat-boats (laden with 100,000 spokes, 2,000,000 feet lumber, 255 tons zinc ore, 75,000 bushels grain, and a large quantity of miscellaneous freight)		222

Five steamboats plied upon the river during the year, making 532 trips, and landed at Kingston (mouth of the river) about—

Grain	bushels..	100,000
Coal	do....	15,000
Spokes and hubs	number..	150,000
Produce and general merchandise	pounds..	700,000

Arrangements are making to employ steamboats and barges in the developing iron-ore and coal trade.

The amount herein asked for ($15,000) can be profitably expended in removing the most dangerous channel obstructions and in building the necessary wing-dams at such points as will be most advantageous to the general commerce of the river.

The estimates for improving Clinch River, Tennessee, are	$50,000 00
Amount appropriated	21,000 00
Amount expended	20,889 85

Money statement.

July 1, 1884, amount available		$80 75
Amount appropriated by act approved July 5, 1884		5,000 00
		5,080 75
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$4,944 26	
July 1, 1885, outstanding liabilities	26 34	
		4,970 60
July 1, 1885, amount available		110 15

Amount (estimated) required for completion of existing project	29,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	15,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

B B 6.

IMPROVEMENT OF DUCK RIVER, TENNESSEE.

No work was done upon this river during the fiscal year, nor since active operations were suspended in 1883.

The following extracts from previous Annual Reports are still applicable:

> The river is now in fair navigable condition from Cartersville to its mouth.
>
> * * * * * * *
>
> Although the work contemplated by the existing project has not all been done, it is believed that the improvement accomplished will answer all the present needs of commerce, for several years at least, and it is therefore respectfully recommended that, unless Congress deems it expedient to appropriate at least one-half of the amount estimated for as necessary to complete the existing project, no further appropriation be made at present.

No commercial statistics have been obtained.

The original estimate of improving Duck River, Tennessee, was	$35,118
Amount appropriated	13,000
Amount expended	13,000

Money statement.

Amount (estimated) required for completion of existing project	$22,118 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

B B 7.

IMPROVEMENT OF CANEY FORK RIVER, TENNESSEE.

The Caney Fork River lies wholly in the State of Tennessee, rising in the Cumberland Mountains, about 18 miles east of Sparta. It empties into the Cumberland River near Carthage, Tenn., about 120 miles above Nashville.

The plan of improvement is based upon an examination made in 1879, and contemplates the removal of channel obstructions and the building of wing-dams, so as to enable steamboats of 3 feet draught to ply between Nashville and the head of navigation at Sligo's Ford, 80 miles above the river's mouth, during the five months when the Cumberland River is usually at a good boating stage, *i. e.*, from February until July.

Work was resumed on this river August 8, 1884, with a small force under local charge of Assistant Engineer C. A. Turrill, and continued until October 19, when the available funds were exhausted.

The work was a continuation of that done in 1883, and consisted:

1st. Of snag-boat work, including the removal of stumps and loose rock where found in channel.

2d. Removal of gravel bars and building riprap dams at special points, most of which had been worked upon during former seasons.

Snag-boat operations were begun at Eagle Creek, 3 miles below Sligo's Ford, and completed to the mouth of the river.

Special work was done at the following places: Phillips' Island, Foster's Island, Hall's Rock Island, Smith's Fork Island, Trousdale's Ferry Bar, and Chandler's or Double Island; six in all.

The following are the items of work done:

Rock quarried for riprap	cubic yards	600
Rock placed in riprap dams	do	600
Riprap dam built	linear feet	310
Gravel excavated	cubic yards	2,540
Loose rock excavated	do	55
Trees cut down	number	610
Snags removed	do	354
Stumps extracted	do	450
Trees topped	do	52
Trees deadened	do	143

The operations at special shoals have in general resulted in the removal of the obstructions as intended.

During the past year fewer trips have been made upon this river than for the two preceding years on account of short crops and a general lack of business. Thirteen trips were made—four to Trousdale's Ferry, 15 miles above mouth, the remainder to points higher up, one only reaching Sligo's Ford. It is estimated that 220 rafts were brought to Nashville from points on this river during the year, and that about 54,000 bushels of corn were shipped down the river.

Navigation on the Caney Fork has not been attempted at any low stage of water during the year, but river men seem to have an increased confidence in its navigability, and an increased number of pilots have been licensed for this river during the year.

The amount asked for ($13,228) can be profitably applied in removing reefs and snags, building wing-dams, cutting overhanging trees, &c., as contemplated in the original plan of improvement.

The estimate for improving the Caney Fork River, Tennessee	$30,228 00
Amount appropriated	17,000 00
Amount expended	16,569 28

Money statement.

July 1, 1884, amount available		$3 29
Amount appropriated by act approved July 5, 1884		3,000 00
		3,003 29
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,556 32	
July 1, 1885, outstanding liabilities	16 25	
		2,572 57
July 1, 1885, amount available		430 72
Amount (estimated) required for completion of existing project		13,228 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		13,228 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

B B 8.

LITTLE TENNESSEE RIVER, TENNESSEE.

The Little Tennessee River rises in the Blue Ridge, and flowing in a northwesterly direction empties into the Tennessee River near Lenoir's Station.

Examinations of this stream were made in 1874, 1875, and 1882; upon these the plan of improvement is based. It consists in the removal of snags, bowlders, reefs, &c., from a channel 40 feet in width and in building wing-dams, so as to give a depth of 2 feet from its mouth to the Tellico River, a distance of 13 miles.

There being no funds available, no work was done during the past fiscal year. The boats, tools, &c., pertaining to this river were transferred to the Tennessee River, above Chattanooga, where some of them could be used, and the remainder stored and cared for without expense to the Little Tennessee.

No commercial statistics have been obtained, but it is known that the region tributary to this stream abounds in timber, grain, and minerals, which have no other practicable outlet.

The appropriation herein estimated for ($10,000) can be profitably expended in continuing the work of removing surface obstructions in the channel and in building wing-dams where necessary below the mouth of the Tellico River.

Estimate for improving the Little Tennessee River from its mouth to Tellico River	$23,724
Amount appropriated	5,000
Amount expended	5,000

Money statement.

July 1, 1884, amount available	$64 13
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	64 13
Amount (estimated) required for completion of existing project	18,724 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

B B 9.

IMPROVEMENT OF SOUTH FORK OF THE CUMBERLAND RIVER, KENTUCKY.

Rising in Tennessee this river flows north into Kentucky and empties into the Cumberland River at Point Burnside. That portion above the mouth of Clear Fork is known as New River.

From its mouth to Dick's Jumps, 31 miles, the river is from 200 to 400 feet wide with a total fall of 76 feet. Above this point numerous sandstone bowlders of immense size are scattered in its bed, rendering improvements at a reasonable cost impossible.

The present plan of improvement, based upon an examination made in 1881, consists in removing bowlders, excavating a channel through rock reefs and gravel bars, and building riprap dams to contract the water-way, so as to secure safe navigation when there is a tide of at least 3 feet above low water.

Active operations were resumed early in October, 1884, at Sloan's Shoals, and continued, in local charge of Assistant Engineer W. O. Crozer, with an average force of men, until February, 1885, when the available funds were exhausted.

The season's work was confined entirely to Sloan's Shoals and Robert's Mill Shoal, and suffered from several interruptions, caused by sudden rises in the river.

The following are the items of work done:

Solid rock blasted from channel	cubic yards	556
Loose rock excavated	do	368
Stone quarried for riprap	do	108
Riprap dams built	do	1,665
Trees cut down and removed	number	161

No commercial statistics have been obtained, but the present commerce is principally in saw-logs.

There are numerous outcrops of coal of splendid quality along the banks of the river awaiting its improvement to be mined and shipped to market.

The amount asked for ($10,000) can be applied to carrying forward the present plan of improvement from the mouth of the river to Devil's Jumps, near the Kentucky State line. Most of the projected work will be practically permanent.

The original estimate of cost of improving South Fork of the Cumberland River, Kentucky, was	$62,803 00
Amount appropriated	7,000 00
Amount expended	6,867 30

Money statement.

July 1, 1884, amount available		$1,255 28
Amount appropriated by act approved July 5, 1884		4,000 00
		5,255 28
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,120 33	
July 1, 1885, outstanding liabilities	2 25	
		5,122 58
July 1, 1885, amount available		132 70
Amount (estimated) required for completion of existing project		55,803 00
Amount that can be profitably expended in fiscal year ending June 30, 1877		10,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

B B 10.

PRELIMINARY EXAMINATION OF ELK RIVER, TENNESSEE AND ALABAMA.

UNITED STATES ENGINEER OFFICE,
Chattanooga, Tenn., October 16, 1884.

GENERAL: In compliance with letter of the Chief of Engineers of July 31, 1884, I have the honor to report upon the Elk River, Tennessee and Alabama. This stream is one of the largest tributaries of the Tennessee, if not the largest, below Chattanooga, but it enters the Tennessee opposite the Elk River Shoals, and is inaccessible to steamboats, excepting at flood stages of the Tennessee.

During these favorable stages steamboats have sometimes ascended the Elk for some distance, and there is said to be a large tract of valuable timber land in its vicinity.

On the completion of the Muscle Shoals Canal the mouth of Elk River will be more accessible to boats from the Tennessee, and the lumber and flat boat trade will probably be such as to justify the improvement of the Elk River, but at present it would hardly be considered as a "river worthy of improvement."

Very respectfully, your obedient servant,

W. R. KING,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B B 11.

PRELIMINARY EXAMINATION OF LITTLE RIVER, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Chattanooga, Tenn., October 16, 1884.

GENERAL: In compliance with letter of the Chief of Engineers of July 31, 1884, I have the honor to report that Little River, Kentucky, is a small stream entering the Cumberland near Cadiz, Ky., and its small size alone would be sufficient to exclude it from the list of rivers "worthy of improvement;" but in view of the fact that effort is being made to secure a thorough improvement of the Cumberland River by means of locks and dams, and as such an improvement, by a proper location of dams, might furnish slack-water navigation for some distance up the Little River, it would seem premature to make any survey or examination of the latter with a view to its independent improvement.

Very respectfully, your obedient servant,

W. R. KING,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B B 12.

REPORT UPON THE CONDITION OF THE CUMBERLAND RIVER ABOVE THE MOUTH OF THE JELLICO, IN KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Chattanooga, Tenn., October 30, 1884.

GENERAL: Having sufficient data, based upon examinations in 1878, and 1880, reports of resources, &c., I have the honor to make the following report of such preliminary examination of "the condition of * * * the Cumberland River above the mouth of the Jellico in Kentucky, and the provisions and estimate of cost necessary to relieve the same from incumbrance, with a view to such legislation as will render the same free to commerce at the earliest practicable period, Ky."

In 1880, Capt. (then Lieut.) William L. Marshall, Corps of Engineers, made an examination and a detailed report of the resources of the country bordering on the Upper Cumberland River above the falls, Kentucky, and estimates submitted for the improvement above the mouth of Jellico to Pineville, $55,000, upon which estimate Congress appropriated $15,000, of which sum $5,300 remain unexpended.

In view of these facts this section of the river is deemed "worthy of improvement," and has been improved, as projected, so far as the condition of the stream will permit of; being now encumbered by dams and a corporate franchise granted by the State of Kentucky, April 27, 1882, as set forth in my annual report for 1883.

The "incumbrance" referred to in the act of July 5, 1884, is doubtless this State charter and the dams erected by State authority. This charter right, by limitation, expires on April 27, 1885, the terms being that work must be commenced within three years from date of passage, unless, as I have been informed, the Kentucky State Legislature has already repealed the charter; but I have no official knowledge of that fact.

I respectfully suggest that this provision in act of July 5, 1884, is apparently interjected among the examinations and surveys so as to be classified under "Kentucky," the term "*condition of * * the Cumberland River*," having reference especially to the questions of "incumbrance" and "legislation."

If to ascertain the "provisions and estimates of cost necessary to relieve the same from incumbrance" it is obligatory to obtain *official* information as to the existence or repeal of the charter, and value of the dams by *voluntary* purchase, an estimate of their actual value having already been made, I respectfully submit that about $75 of the $450 already allotted by letter of September 4 will probably be sufficient for that purpose.

Very respectfully, your obedient servant,

W. R. KING,
Major of Engineers.

The CHIEF ON ENGINEERS, U. S. A.

B B 13.

PRELIMINARY EXAMINATION OF HOLSTON RIVER, TENNESSEE.

UNITED STATES ENGINEER OFFICE,
Chattanooga, Tenn., October 30, 1884.

GENERAL: In compliance with letter of the Chief of Engineers of July 31, I have the honor to report that the "Holston River, Tennessee" is, in my opinion, "worthy of improvement" for the reasons set forth in detail in a report on the resources and obstructions of this stream by Col. S. H. Long, in 1830, and a report of a re-examination made under my direction by Mr. W. G. Sanborn, in 1881, both of which reports give the nature of the obstructions and the commercial interests to be benefited by said improvement, together with detailed estimates of the cost of improvement.

The reports in question having been laid before Congress, and no appropriation having been made for beginning the work, nothing has been done in the way of improvements; but the interests of commerce are fully as great now as they were when the last examination was made. In view of these facts, it does not appear that any survey or examination is necessary, not because the stream is unworthy of improvement, but because the examinations and estimates already made are sufficient for beginning the work, if Congress decides to make an appropriation.

It would, perhaps, be worth while, though not absolutely essential, at this time to take up Mr. Sanborn's reconnaissance below Noe's Branch and continue it to Knoxville, a distance of nearly 80 miles, to procure data and sketches of the various obstructions in their present condition, and should it be deemed best to do this, it can be paid for from the balance ($275) of the $450 already allotted to this district.

Very respectfully, your obedient servant,

W. R. KING,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B B 14.

PRELIMINARY EXAMINATION WITH A VIEW TO THE EXTENSION OF THE SURVEY OF CANEY FORK RIVER TO FRANK'S FERRY, TENNESSEE.

UNITED STATES ENGINEER OFFICE,
Chattanooga, Tenn., October 16, 1884.

GENERAL: In compliance with letter of the Chief of Engineers of July 31, I have the honor to report upon the extension of the survey of Caney Fork River to Frank's Ferry, Tennessee.

The examination of Caney Fork River and the subsequent improvement of that stream since appropriations have been made have been limited to that stream below Sligo Ford, but it is understood that a short reach of river above the ford is equally "worthy of improvement," and as this would be simply an extension of a work already authorized by Congress, and as an examination of the stream from Frank's Ferry to Sligo could be made for less than $100, I would respectfully recommend that such an examination be authorized, to be paid for from the funds already allotted for preliminary examinations in this district.

Very respectfully, your obedient servant,

W. R. KING,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX C C.

IMPROVEMENT OF THE OHIO, MONONGAHELA, AND ALLEGHENY RIVERS—OPERATING AND CARE OF THE LOUISVILLE AND PORTLAND CANAL; OF DAVIS ISLAND LOCK AND DAM, AND OF LOCK AND DAM ON MONONGAHELA RIVER—CONSTRUCTION OF ICE-HARBOR AT MOUTH OF THE MUSKINGUM, AND HARBORS OF REFUGE NEAR CINCINNATI AND AT MOUTH OF THE GREAT KANAWHA.

REPORT OF LIEUTENANT-COLONEL WILLIAM E. MERRILL, CORPS OF ENGINEERS, BVT. COL., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Ohio River.
2. Operating and care of Davis Island Lock and Movable Dam, Ohio River.
3. Operating and care of Louisville and Portland Canal.
4. Falls of the Ohio River at Louisville, Kentucky.
5. Monongahela River, West Virginia and Pennsylvania.
6. Operating and care of Lock and Dam No. 9, Monongahela River.
7. Allegheny River, Pennsylvania.
8. Ice-harbor at mouth of Muskingum River, Ohio.
9. Harbor of refuge near Cincinnati, Ohio.
10. Harbor of refuge at mouth of Great Kanawha River, West Virginia.

EXAMINATIONS AND SURVEYS.

11. Shawneetown Harbor and Levee, Illinois.
12. New Albany Harbor, Indiana, and the river and shores adjacent to said harbor.
13. Harbor at Paducah, Kentucky.
14. Harbor at Owensborough, Kentucky.
15. Scioto River, Ohio.
16. Lawrenceburg Harbor, Indiana.
17. Bar in the Ohio River opposite the mouth of the Licking River, Kentucky.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, July 1, 1885.

GENERAL: I have the honor to submit herewith the annual reports on the works under my charge for the fiscal year ending June 30, 1885.

Since September 18, 1884, I have been assisted by First Lieut. G. W. Goethals, Corps of Engineers.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

C C I.

IMPROVEMENT OF THE OHIO RIVER.

On the 1st of July, 1884, the following contract was outstanding:

Date.	Locality.	Miles below Pittsburgh.	Work.	Contractor.
July 12, 1879	Head of Grand Chain	944	Dike	C. M. Cole.

The river and harbor act approved July 5, 1884, contained the following item:

Improving the Ohio River, continuing improvement, six hundred thousand dollars. Of this sum seventy thousand dollars, or so much thereof as may be necessary for the completion of the Davis Island Dam, shall be expended on that work. Fifty thousand dollars shall be used in continuing work on the upper and lower dikes and other improvement at Grand Chain, and seven thousand five hundred dollars for the ice-harbor at the mouth of the Great Kanawha, and fifty thousand dollars, or so much thereof as may be necessary, for the improvement of the navigation of the river at Jeffersonville and the protection of the Government property.

With the funds thus obtained it was decided, with the approval of the Chief of Engineers, to let a number of contracts, as shown by the accompanying abstracts of proposals.

By advertisement dated July 19, 1884, proposals were invited for towing, in connection with the United States dredges Ohio and Oswego.

The following bids were received and opened on August 5, 1884:

Proposals for towing.

No.	Bidders.	Tow-boats.	Price per day.
1	Joseph Graham	Iron City	$35 00
2	James B. Thompson	Frank Stein	38 00
3	S. W. Coflin	Alex. Montgomery	47 50
4	John Chatelier	Maggie Bell	48 00
5	J. P. Capehart	Katie Timmonds	48 00
6	Warren Elsey	Resolute	49 00
7	W. M. Clark	J. M. Clark	50 00
8	Murray & Mecklethwaite	Excel	91 00

Contract was awarded to James B. Thompson, and executed under date of August 18, 1884. The Iron City was found, on examination, to be unsuited to the work.

By advertisement dated July 19, 1884, proposals were invited for furnishing iron work for the Davis Island Dam. The following bids were received and opened on August 26, 1884:

Proposals for iron work for Davis Island Dam.

No.	Bidders.	Machinery.						Wrought-iron pipe, 13,612 pounds.	
		Price per pound of wrought iron, 30,469 pounds.	Price per pound of cast iron, 91,470 pounds.	Price per pound of brass, 792 pounds.	Price per pound of steel, 763 pounds.	Price per pound of leather, 43 pounds.	Total.	Per pound.	Total.
		Cents.	*Cents.*	*Cents.*	*Cents.*	*Dollars.*	*Dollars.*	*Cents.*	*Dollars.*
1	Scaife Foundry and Machine Company, limited.	07. 5	05	11	80	2 75	7, 369 73*	....	....
2	Atlas Works, limited..	09. 4	06. 8	27	49	90	9, 709 83	07	952 84
3	H. A. Ramsay & Co	09. 9	07. 9	13⅞	49⅞	2 75	10, 861 68	....	....
4	William Fisher	10⅞	07. 8	23	56	75	14, 099 42	....	....
5	P. W. Reinhagers	14⅜	14⅜	14⅜	14⅜	14⅜	17, 758 44	....	....
6	Kreiger, Burkhardt & Co.	15	15	20	82	1 00	19, 135 89	....	....
7	William Kirkup and Son.	....	....	....	....	....	....	06	816 72*
8	R. D. Wood & Co	....	....	....	....	....	....	....	....
9	Queen City Bridge and Steam Forging Company.	....	....	....	....	....	....	....	....
10	J. W. Foley & Co......	....	....	....	....	....	....	....	....
11	Oliver Brothers and Phillips.	....	....	....	....	....	....	....	....
12	Nunning & Labbering..	....	....	....	....	....	....	....	....
13	Cincinnati and Newport Iron and Pipe Company.	....	....		....	....	....	....	....

* Accepted.

No.	Bidders.	Cast-iron pipe, 41,483 pounds.		Cast-iron plates, 18,406 pounds.		Bolts, nuts, and washers, 57.275 pounds.	
		Per pound.	Total.	Per pound.	Total.	Per pound.	Total.
		Cents.	*Dollars.*	*Cents.*	*Dollars.*	*Cents.*	*Dollars.*
1	Scaife Foundry and Machine Company, limited.	....	....	02. 9	533 77	....	....
2	Atlas Works, limited	03. 4	1, 410 42	03. 4	625 80	04. 7	2, 405 55
3	H. A. Ramsay & Co	....	....	....	....	....	....
4	William Fisher	....	....	03. 5	644 21	....	....
5	P. W. Reinhagers	....	....	....	....	....	....
6	Kreiger, Burkhardt & Co	....	....	....	....	....	....
7	William Kirkup & Son.............	....	....	....	....	....	....
8	R. D. Wood & Co	*02. 057	853 39	....	....	....	....
9	Queen City Bridge and Steam Forging Company.	02. 5	1, 037 07	02. 5	460 15†	03⅞	2, 219 40
10	J. W. Foley & Co			03⅞	713 23	....	....
11	Oliver Brothers and Phillips	....	....	....	....	03. 5	†2, 004 62
12	Nunning & Labbering	....	....	....	....	04	2, 291 00
13	Cincinnati and Newport Iron and Pipe Company.	02. 2	†912 63	....	....	....	....

* Estimated price per pound rejected for informality. † Accepted.

Contracts for furnishing the above iron work were entered into, as follows:

(1) *Machinery.*—With Scaife Foundry and Machine Company, of Pittsburgh, Pa., September 12, 1884.

(2) *Wrought-iron pipe.*—With William Kirkup & Son, of Cincinnati, Ohio, September 4, 1884.

(3) *Cast-iron pipe.*—With Cincinnati and Newport Iron and Pipe Company, of Newport, Ky., September 13, 1884.

(4) *Cast-iron plates.*—With Queen City Bridge and Steam Forging Company, of Cincinnati, Ohio, September 13, 1884.

(5) *Bolts, nuts, and washers.*—With Oliver Brothers & Phillips, of Pittsburgh, Pa., September 10, 1884.

On September 26, 1884, a contract was made with Fairbanks & Co., of Indianapolis, Ind., to construct two water-tanks at the Davis Island Dam for $3,740.

This proposal was the only one received in answer to advertisement of July 19, 1884.

By circular letter dated July 22, 1884, proposals were invited for furnishing cement for use at Davis Island Dam.

The following bids were received, and were opened on August 14, 1884:

Proposals for cement for Davis Island Dam.

No.	Bidders.	Barrels required.	Price.	Cost.	Remarks.
1	Union Akron Cement Company	400	$1 30	$520	Rejected.
2	F. O. Norton	400	1 40	560	
3	L. S. McKallip & Co	400	1 45	580	
4	Laing & Davidson	400	1 55	620	

Contract awarded to F. O. Norton, of New York City, and executed under date of August 25, 1884.

By advertisement dated August 27, 1884, proposals were invited for furnishing materials and constructing dams and dikes on the Ohio River.

The following proposals were received and opened on September 30, 1884:

Proposals for dike at Merriman Bar, 9 miles below Pittsburgh.

No.	Bidders.	Materials required.					Total.
		Price per M feet of oak (432,800 feet, B. M.).	Price per cubic yard of stone (10,900 cubic yards).	Price per pound of drift-bolts (10,824 pounds).	Price per pound of spikes (2,662 pounds).	Price per cord of brush (77 cords).	
5	John B. Holbrook	$27 00	$0 85	$0 05	$0 05	$3 50	$21,877 66
8	I. V. Hoag, jr	22 00	1 24	03	04	1 00	23,532 16
46	Simon Carmody and Robert L. Mapel	28 50	1 20	07	06	1 75	26,449 65
44	C. B. Willey	27 00	1 40	05	05	1 50	27,718 66
37	Jacob Friday	28 00	1 35	06	06	1 50	27,739 70
3	Porter, Tucker & Mahan	33 75	1 20	05	10	1 00	28,650 47
38	John Swan	29 00	1 60	05	05	3 50	30,917 02
17	R. G. Huston & Co	32 00	1 50	06	06	2 50	31,181 42
32	Edwin G. Graham	35 00	1 70	06	06	3 00	34,696 46
31	William B. Rogers	36 00	1 95	05	03⅛	5 00	34,722 85
19	Jonte, Barton & Crane	30 00	2 00	05	05	8 00	35,755 70
18	Merrington & Jutte	38 00	1 75	03¼	05¼	1 50	36,104 87
42	J. Sharp McDonald	43 00	2 25	03⅛	03⅛	5 00	43,965 75
10	C. J. McDonald & Co	39 50	2 63	03⅛	04$\frac{87}{100}$	2 47	45,441 78

Contract awarded to John B. Holbrook, and executed under date of October 22, 1884.

Proposals for constructing dam at Black's Island, 54 miles from Pittsburgh, and repairing dam at Brown's Island, 63 miles below Pittsburgh.

No.	Bidders.	Materials required.						Total.
		Price per M feet of oak (345,250 feet, B. M.).	Price per M of hemlock (138,975 feet, B. M.).	Price per cubic yard of stone (13,325 cubic yards).	Price per pound of drift-bolts (28,057 pounds).	Price per pound of spikes (4,425 pounds).	Price per cord of brush (88 cords).	
5	John B. Holbrook*	$24 00	$23 00	$0 70	$0 05	$0 05	$3 00	$24, 098 42
3	Porter, Tucker & Mahan	30 00	23 75	95	05	10	1 00	30, 150 25
8	I. V. Hoag	22 00	18 00	1 25	03	04	1 00	30, 360 01
44	C. B. Willey	27 00	21 00	1 12½	05	05	1 50	31, 236 94
46	Simon Carmody and Robert L. Mapel	28 50	28 50	1 20	07	06	1 75	34, 573 90
37	Jacob Friday	29 00	20 00	1 39	06	06	1 50	36, 174 42
17	R. G. Huston & Co	32 00	30 00	1 45	06	06	2 50	39, 607 42
28	John Swan	29 00	20 00	1 70	05	05	3 50	40, 776 35
12	A. J. Jolly, Sons & Co	38 75	32 75	1 63	09	12	2 75	47, 207 75
19	Jonte, Barton & Crane	32 00	30 00	2 00	05	05	8 00	48, 195 35
32	Edwin E. Graham	35 00	25 00	1 70	06	06	3 00	49, 002 29
13	Merrington & Jutte	38 00	27 00	2 07	03½	05½	1 50	49, 879 73
10	C. J. McDonald & Co	37 50	27 00	2 37	03½	05	2 47	54, 450 04
14	T. S. Freeland	45 00	25 00	10 50	04	04	8 00	181, 926 40

* Conditional bid. Withdrawn in accordance with letters accompanying proposal.

Contract awarded to Porter, Tucker & Mahan, and executed under date of November 4, 1884.

Proposals for dam at Wheeling Island, 91 miles below Pittsburgh.

No.	Bidders.	Materials required.					Total.
		Price per M. feet of oak (557,360 feet B. M.).	Price per cubic yard of stone (7,446 cubic yards).	Price per pound of drift bolts (35,806 pounds).	Price per pound of spikes (6,600 pounds).	Price per cubic yard of excavation (2,000 cubic yards).	
8	I. V. Hoag, jr	$24 00	$1 40	$0 03	$0 04	$0 10	$25, 467 22
44	C. B. Willey	27 00	1 20	05	05	25	26, 878 22
3	Porter, Tucker & Mahan	30 00	1 00	05	10	20	27, 237 10
46	Simon Carmody and Robert L. Mapel	28 50	1 20	07	06	23	28, 431 38
34	Prince & Kuglen	30 00	1 50	03	02½	35	30, 308 98
17	R. G. Huston & Co	33 00	1 60	06	06	45	34, 232 84
32	Edwin E. Graham	35 00	1 70	06	06	....	34, 744 16
19	Jonte, Barton & Crane	32 00	2 00	05	05	65	36, 837 82
39	Keily & Ryan	30 00	2 50	08	06	25	39, 396 28
10	C. J. McDonaid & Co	37 37	2 27	03½	05	24	40, 079 57
16	Arnold S. Radford	40 00	2 25	05	05	30	42, 113 20
42	J. Sharp McDonald	51 00	2 60	03½	03½	25	50, 071 17
15	J. C. Wilkins & Co	60 00	4 00	03½	04	5 00	79, 822 81

Contract was awarded to I. V. Hoag, jr., and executed under date of December 1, 1884.

Proposals for dam at Captina Island, 107 miles below Pittsburgh.

No.	Bidders.	Materials required.						Total.
		Price per M. feet of oak (234,770 feet B. M.).	Price per M. feet of hemlock (94,500 feet B. M.).	Price per cubic yard of stone (10,420 cubic yards).	Price per pound of drift bolts (19,080 pounds).	Price per pound of spikes (3,010 pounds).	Price per cord of brush (60 cords).	
5	John B. Holbrook	$25 00	$23 00	$0 75	$0 05	$0 05	$3 00	$17,142 25
8	I. V. Hoag, jr	23 00	16 00	1 30	03	04	1 00	21,210 57
26	R. Merydith & Sons	28 00	23 00	1 13	03½	03½	2 00	21,414 81
28	Dawes, Irish & Co	28 75	26 25	1 08	03½	07	1 50	21,452 45
3	Porter, Tucker & Mahan	30 00	25 00	1 05	05	10	1 50	21,601 60
29	McGrath & Fickinger	29 00	24 00	1 20	04½	06	1 50	22,709 53
46	Simon Carmody and Robert L. Mapel	28 50	28 50	1 20	07	06	1 75	23,509 39
17	R. G. Houston & Co	28 00	27 00	1 40	06	06	2 25	25,173 46
1	J. F. King	28 50	25 00	1 60	04½	04½	1 00	26,779 49
32	Edwin E. Graham	35 00	25 00	1 70	06	06	....	29,618 85
19	Jonte, Barton & Crane	35 00	30 00	2 00	05	05	8 00	33,476 45
10	C. J. McDonald & Co	37 37	27 00	2 27	03½	05	2 47	34,317 55
12	A. J. Jolly Sons & Co	37 75	35 00	1 95	12	12	2 70	35,301 86
42	J. Sharp McDonald	45 50	38 00	2 45	03½	03½	3 00	40,755 18

The contract was awarded to John B. Holbrook, and executed under date of October 22, 1884.

Proposals for dam at Fish Creek Island, 112 miles below Pittsburgh.

No.	Bidders.	Materials required.						Total.
		Price per M. feet of oak (234,770 feet B. M.).	Price per M. feet of hemlock (94,500 feet B. M.).	Price per cubic yard of stone (10,420 cubic yards).	Price per pound of drift bolts (19,080 pounds).	Price per pound of spikes (3,010 pounds).	Price per cord of brush (60 cords).	
5	John B. Holbrook	$25 00	$23 00	$0 85	$0 05	$0 05	$3 00	$18,184 25
8	I. V. Hoag, jr	23 00	16 00	1 30	03	04	1 00	21,210 51
26	R. Merydith & Sons	28 00	23 00	1 13	03½	03½	2 00	21,414 81
28	Dawes, Irish & Co	28 75	26 75	1 08	03½	07	1 50	21,452 45
3	Porter, Tucker & Mahan	30 00	25 00	1 05	05	10	1 50	21,601 60
29	McGrath & Fickinger	28 50	24 00	1 25	04½	06	1 50	23,123 14
46	Simon Carmody and Robert L. Mapel	28 50	28 50	1 20	07	06	1 75	23,509 39
1	John F. King	27 00	22 00	1 40	04½	04½	1 00	24,059 84
17	R. G. Huston & Co	28 00	27 00	1 50	06	06	2 25	26,215 46
32	Edwin E. Graham	35 00	25 00	1 70	06	06	3 00	29,798 85
19	Jonte, Barton & Crane	35 00	30 00	1 75	05	05	7 00	30,761 45
10	C. J. McDonald & Co	37 37	27 00	2 37	03½	05	2 47	34,317 55
12	A. J. Jolly Sons & Co	38 75	36 25	1 87	09	12	2 75	35,736 75
42	J. Sharp McDonald	44 00	39 00	2 45	03½	03½	5 00	40,617 18

Contract was awarded to John B. Holbrook, and executed under date of October 22, 1884.

Proposals for dam at Three Brothers, 157 miles from Pittsburgh.

No.	Bidders.	Materials required.						Total.
		Price per M. feet of oak (331,440 feet B. M.).	Price per M. feet of hemlock (133,416 feet B. M.).	Price per cubic yard of stone (14,712 cubic yards).	Price per pound of drift bolts (26,952 pounds).	Price per pound of spikes (4,248 pounds).	Price per cord of brush (84 cords).	
1	John F. King	$25 50	$22 00	$0 97½	$0 04½	$0 04½	$1 00	$27, 319 07
28	Dawes, Irish & Co	27 25	26 25	98½	03½	07	1 40	28, 888 51
35	C. M. Cole	24 00	22 00	1 06	06	05	1 50	28, 470 95
8	I. V. Hoag, jr	23 00	16 00	1 25	03	04	1 00	29, 210 85
36	R. Merydith & Sons	26 00	22 00	1 13	03½	03½	2 00	29, 437 15
3	Porter, Tucker & Mahan	29 00	25 00	1 08	05	10	1 50	30, 138 92
29	McGrath & Fickinger	28 00	24 00	1 20	04½	06	1 50	30, 731 22
46	Simon Carmody and Robert L. Mapel	28 50	28 50	1 20	07	06	1 75	33, 192 31
17	R. G. Huaton & Co	27 50	27 00	1 40	06	06	2 25	35, 374 63
42	J. Sharp McDonald	44 00	38 00	2 48	03½	03½	3 00	37, 084 16
19	Jonte, Barton & Crane	30 00	25 00	1 75	04	04	6 00	40, 776 60
32	Edwin E. Graham	35 00	25 00	1 70	06	06	3 00	42, 070 20
12	A. J. Jolly Sons & Co	36 75	35 00	1 75	09	12	2 70	45, 762 42
10	C. J. McDonald & Co	37 37	27 00	2 28	03½	05	2 47	50, 159 10
47	J. M. Sturm	28 00	23 00	2 95	06	06	1 60	57, 756 68

Contract awarded to John F. King, and executed under date of October 23, 1884.

Proposals for dike at Sand Creek, 220 miles below Pittsburgh.

No.	Bidders.	Materials required.			Total.
		Price per M feet of oak (284,560 feet, B. M.).	Price per cubic yard of stone (10,311 cubic yards).	Price per pound of spikes (20,813 pounds).	
2	J. C. Graham	$23 50	$0 83½	$0 04	$16, 129 36
35	C. M. Cole	24 00	96	06	17, 966 78
8	I. V. Hoag, jr	22 00	1 25	03½	19, 877 52
3	Porter, Tucker & Mahan	29 00	1 06	06	20, 430 63
46	Simon Carmody and Robert L. Mapel	28 50	1 20	*07 †06	21, 898 47
17	R. G. Huston & Co	27 50	1 40	06	23, 509 58
19	Jonte, Barton & Crane	30 00	1 75	04	24, 835 82
20	Sheldon S. Eaton	25 00	2 00	05	28, 776 75
45	F. Keating	34 50	1 90	04	30, 240 74
12	A. J. Jolly, Sons & Co	41 00	1 95	12	34, 220 97
10	C. J. McDonald & Co	38 37	2 47	03½	37, 115 18
47	J. M. Sturm	30 00	2 95	06	40, 203 03

* Bolts. † Spikes.

Contract awarded to J. C. Graham, and executed under date of October 27, 1884.

Proposals for dike at Eight Mile Bar, 453 miles below Pittsburgh.

No.	Bidders.	Materials required.			Total.
		Price per M feet of oak (463,333 feet, B. M.).	Price per cubic yard of stone (15,811 cubic yards).	Price per pound of drift-bolts and spikes (31,913 pounds).	
9	Ware & Pyle*	$18 45	$0 83	$0 04½	$22,609 55
4	J. J. Shipman	19 00	94	04½	24,588 74
2	J. C. Graham	24 75	94	04	26,938 10
35	W. H. Wheeler	26 50	94	03	27,582 45
5	John B. Holbrook	24 00	1 10	05	29,459 74
19	Jonte, Barton & Crane	23 75	1 20	04	30,612 61
22	P. H. Kelley	28 00	1 10	04	30,885 94
21	H. S. Hopkins & Co	28 00	1 17	05	32,311 84
8	I. V. Hoag, Jr	20 00	1 50	08	33,400 55
46	Simon Carmody and Robert L Mapel	28 50	1 20	†07 ‡06	33,587 27
17	R. G. Huston & Co	29 00	1 35	06	34,958 28
41	P. Kendrick & Co	30 00	1 45	04	37,292 36
24	L. Hommedieu & Bloom	35 00	1 50	04	40,264 61
20	Sheldon S. Eaton	28 00	1 75	05	41,482 22
28	M. D. Burke & Co	30 00	2 00	05	46,307 64
10	C. J. McDonald & Co	43 00	2 87	03½	65,250 33
18	A. B. Cole	27 49	4 70	02.85	86,216 01

* Informal. † Bolts. ‡ Spikes.

Contract awarded to John J. Shipman, and executed under date of November 28, 1884.

Proposals for dike at Rising Sun, 502 miles below Pittsburgh.

No.	Bidders.	Materials required.								Total.
		Price of piles (1,350).	Price per cord of brush (7,500 cords).	Price per cubic yard of stone (18,000 cubic yards).	Price per pound of bolts, nuts, and washers (2,150 pounds).	Price per M of oak (261,000 feet, B. M.).	Price per M of pine (59,600 feet, B. M.).	Price per pound of drift-bolts (24,600 pounds).	Price per pound of spikes (830 pounds).	
9	Ware & Pyle*	$4 00	$2 25	$0 83	$0 04½	$18 45	$17 45	$0 04½	$0 04½	$44,316 95
7	Kirk & Co	2 50	1 60	1 10	07	28 00	23 00	07	07	44,479 40
22	P. H. Kelley	3 00	1 50	1 00	04½	30 00	28 00	04	04	44,912 75
46	Simon Carmody and Robert L. Mapel	1 15	1 75	1 20	07	28 50	30 00	07	06	49,426 00
4	J. J. Shipman	7 75	2 50	1 20	07	20 00	20 00	04½	05	50,423 50
33	Boyer & Stites	7 40	2 30	95	08	18 00	18 00	03¾	05	51,442 55
8	I. V. Hoag, jr	2 50	3 00	1 20	05	20 00	20 00	03	04	54,776 70
41	P. Kendrick & Co	3 95	2 25	1 60	05	30 00	29 50	04	05	56,929 45
5	J. B. Holbrook	7 00	2 50	1 10	07	25 00	25 00	05	05	57,438 40
21	H. S. Hopkins & Co	3 75	3 40	1 21	04	28 00	27 50	04	07	62,515 60
11	B. C. Howell	5 50	1 75	1 96	04½	24 75	30 00	05	05	65,446 00
28	M. D. Burke & Co	7 00	2 00	1 80	08	30 00	35 00	05	05	68,209 50
17	R. G. Huston & Co	9 00	2 75	1 50	06	30 00	33 00	06	06	71,226 60
19	Jonte, Barton & Crane	10 00	5 00	1 75	04	24 00	30 00	04	04	91,455 20
43	Hayes, Argo & Co	8 00	1 80	2 60	05	28 00	27 00	03	03	95,870 40
24	L. Hommedieu & Bloom	20 00	4 00	1 50	04	33 00	33 00	04	04	95,688 00
27	Eaton & Stone	11 00	2 80	3 00	05	30 00	30 00	05	05	100,847 00

* Informal.

Contract was awarded to Kirk & Co., and executed under date of October 22, 1884.

Proposals for dike at Flint Island, 683 *miles below Pittsburgh.*

No.	Bidders.	Materials required.								Total.
		Price of piles (1,996).	Price per cord of brush (17,224 cords).	Price per cubic yard of stone (41,078 cubic yards).	Price per pound of bolts, nuts, and washers (3,092 pounds).	Price per M of oak (375,651 feet, B. M.).	Price per M of pine (85,605 feet, B. M.).	Price per pound of drift-bolts (25,150 pounds).	Price per pound of spikes (1,198 pounds).	
6	John H. Morris	$7 50	$0 90	$1 08	$0 08	$26 00	$26 00	$0 05	$0 04	$78, 901 27
7	Kirk & Co	2 50	1 75	1 10	07	22 00	22 00	07	07	93, 226 23
8	I. V. Hoag, jr	2 75	2 75	85	05	18 00	18 00	03	03	96, 320 94
46	Simon Carmody and Robert L. Mapel	1 15	1 75	1 20	07	28 00	30 00	07	06	97, 753 01
25	Joseph Coyne	2 55	2 37	1 10	09	35 00	40 00	07	07	110, 391 10
11	B. C. Howell	6 00	1 80	1 37½	05	24 75	30 00	04	05	112, 947 46
44	C. B. Willey	4 75	1 40	1 65	05	27 00	25 00	05	05	115, 629 99
4	J. J. Shipman	1 75	2 50	1 50	07	21 00	20 00	05	05	119, 504 61
21	H. S. Hopkins and Co	4 00	3 20	1 18	04	28 00	27 50	04	07	124, 005 83
30	Lynch, McQuade & Co	6 00	2 00	1 75	06	29 00	29 00	06	06	134, 053 32
23	M. D. Burke & Co	7 00	2 00	1 75	08	30 00	35 00	05	05	136, 636 96
17	R. G. Huston & Co	10 00	2 75	1 50	06	32 00	35 00	06	06	146, 326 40
19	Jonte, Barton & Crane	12 00	7 00	2 00	05	27 50	30 00	05	05	241, 546 55

The proposal of John H. Morris, of Evansville, Ind., was accepted, but he died before the contract could be made, and so the matter fell through.

Proposals for dike at Grand Chain, 946 *miles from Pittsburgh.*

	Bidders.	Materials required.				Total.
		Oak (1,204,386 feet B. M.), price per M.	Stone (34,028 cubic yards), price per cubic yard.	Drift-bolts (78,006 pounds), price per pound.	Brush (1,200 cords), price per cord.	
				Cents.		
8	I. V. Hoag, jr	$22 00	$1 25	.03	$2 00	$78, 769 17
40	George E. Shoop	27 00	1 24	.07	1 25	81, 671 08
46	Simon Carmody and Robert L. Mapel	28 50	1 20	.07	1 75	82, 716 62
21	H. S. Hopkins & Co	27 50	1 27	.04	3 75	83, 552 85
4	J. J. Shipman	21 00	1 75	.05	2 50	91, 737 90
19	Jonte, Barton & Crane	30 00	2 00	.05	7 00	116, 483 88
17	R. G. Huston & Co	32 00	2 25	.06	2 50	122, 779 21

Contract awarded to I. V. Hoag, jr., and executed under date of December 1, 1884.

As authorized by the Chief of Engineers (letter of January 5, 1885), the following proposals for lengthening the United States snag-boat E. A. Woodruff were received in answer to circular letter from this office, dated January 12, 1885, and opened February 3, 1885.

Proposals for lengthening the United States snag-boat E. A. Woodruff.

No.	Bidders.	New parts of hull to be of iron.	New parts of hull to be of mild steel.
1	Allen & Blaisdell	$16,500	$17,000
2	Queen City Bridge and Steam Forging Company	19,090	19,650

Contract was awarded to Messrs. Allen & Blaisdell, of South Saint Louis, Mo., and executed under date of February 20, 1885.

WORK DONE DURING THE YEAR.

Davis Island Dam, 5 miles from Pittsburgh.—This work has been under the local charge of Mr. William Martin, assistant engineer.

Owing to the late date at which the river and harbor act passed, it was impossible to procure the necessary machinery in time to complete the structure during 1884, and consequently but little was done last season. Work was resumed on May 19, 1885, and by the close of the fiscal year matters were so far advanced as to warrant the assertion that the work would be ready for navigation by the middle of August.

Mr. Martin's report is as follows:

REPORT OF WILLIAM MARTIN, ASSISTANT ENGINEER.

The work done during the year is as follows:

Fixed dam.—The balance of the sheathing on the down-stream face (a width of 4 feet its entire length) of the fixed dam was put on; 200 cubic yards of gravel were placed on up-stream side to prevent leaks. During the flood of February, 1884, considerable scour took place at the base of the right and left hand cribs, and to secure these cribs and prevent further scour 165 cubic yards of riprap stone were placed at left-hand crib and 80 cubic yards were placed at right-hand crib, which puts the fixed dam in good condition. A deposit of about 5 feet has taken place above the dam since its construction.

Water-tanks.—The foundation for the water-tanks, containing 476 cubic yards of masonry, was completed October 31, 1884. The tanks, two in number, having a combined capacity of 79,000 gallons, were completed January 9, 1885, and are first-class in every respect.

The necessary pipe connections between the tanks and gate turbines have been made.

Pier on river wall at foot of lock.—This pier was built 5 feet 3 inches above the coping, and is designed to elevate the mast, which carries the signal lamps, above the ordinary floods. It is 5 feet 3 inches high and 21 feet long, containing 28 cubic yards of masonry.

Traveler sill.—Owing to the abandonment of the traveler, it was decided to remove the lower track sill. Of this work the iron rail has been removed.

Levee on Davis Island.—To protect Davis Island from further damage by floods, a levee has been constructed from a point near the head of the island, running partly across its head and extending down the left-hand shore to the crib work of the fixed dam. This levee is constructed wholly of earth, with the top planted with locust trees and the slopes with willows. This is all the work that at present seems necessary for the protection of the island.

Recess walls, &c.—The upper recess walls and a portion (20 feet) of the land wall coping has been laid—in all, 75 cubic yards of masonry.

Gate machinery.—The machinery for operating the upper lock gate has been placed in position.

Wickets.—All the wickets (27 in number) belonging to the Chanoine Dam at the head of the lock have been ironed.

Coffer-dams.—The coffer-dams inclosing the lock-chamber were begun June 15, 1885, and were finished June 19, 1885. The puddling material for these dams was procured from deposit inside of the guiding cribs.

Lock-gates.—One of the lock-gates has been framed and is ready for erection.

August 21, 1884, we began to raise the service bridge of the weirs, and to fit th platforms to weirs No. 1 and 2 (those of weir No. 3 having been completed). Con siderable difficulty was experienced in raising the trestles on account of the gravel deposited over them, which, in places on weir No. 3, had deposited to a depth of 1.5 feet over the sill. As we approached the pass the deposit became less, until about the middle of weir No. 1, where the trestles were clear.

While a temporary maneuvering boat was being fixed up the wickets of the weirs were raised from the service bridge and a temporary dam built across the head of the lock to prevent the water from passing through the lock when the dam was raised. At noon, on August 26, we began to raise the wickets of the pass with our improvised boat, and we finished the last wicket on the 28th, at noon. As the stage of water in the river at the time of raising the dam was very low, there being but 1.9 feet of water over the sill, there was not enough force in the current to clear the gravel which had deposited on the hurters; owing to this, quite a number of the props were not properly seated, and when the head of water accumulated the wickets were forced down. In raising the second time all deposit was removed.

The dam remained up until October 5, 1884, when a rise in the river compelled us to lower it.

We began to lower the dam from the Davis Island end of weir No. 3, which we did from the service bridge in the following manner: A hook pole was used with its angle about 91° to the axis of the pole so as to release freely; a hold was taken to the top handle plate of the wicket; when the prop was drawn forward far enough to drop off the second step of the hurter the pole was given a twist which released the hook from the handle. By this means, when we were not retarded by driftwood or otherwise, we could drop three wickets per minute. A great deal of large driftwood had accumulated, some of it about 40 feet long, which was difficult to handle in the swift current. This retarded the speed of lowering considerably. Taking all the delays into account, with our temporary appliances, the time occupied per wicket in lowering the whole dam was a little less than two minutes.

Seven of the steel cross-heads in the pass were found broken, five of which were removed and replaced by wrought-iron ones. The other two are yet to be replaced.

Twelve of the female hinge-leaves (steel castings) have also been broken.

In my investigations to determine the cause of the breakages I consulted several manufacturers in Pittsburgh, whose experiences have been similar to ours. None of those interviewed could assign any cause for the breakages. Castings which would appear sound on the surface would be honey-combed internally to such an extent as to reduce the cross-section 20 per cent., and frequently a casting which would present an unsound surface would be sound internally. The fracture generally showed a bright metal resembling white cast-iron. In respect to the future use of steel castings for movable dams, my opinion is that in the present knowledge of the manufacture of steel castings wrought-iron is safer, more reliable, and will stand any amount of jarring consistent with the safety of the structure.

On December 6, 1884, we were notified by the United States signal officer stationed at Pittsburgh that we would be supplied with a daily copy of the flood warnings issued by his office. In accordance with that notice we have been in daily receipt of these warnings.

The work remaining to be done in order to put the dam in operation is as follows:

The framing of the remaining lock-gate, and the erection of both.

The framing and erection of two auxiliary gates.

Placing the timber sills for gate foundations, setting the courses of cut-stone masonry below the lower main sills, concreting between the sills, and paving between the gate-tracks.

Completing the Chanoine Dam at the head of the lock, which consists of putting in six anchor-bolts, placing the hurters in position, putting in horse-box sill and the main sill, and assembling the wickets, horses, and props.

Placing seven filling and two flushing valves in the river wall.

Placing the turbine and pump in the river wall, setting the hydraulic jacks for operating the valves, laying the water-pipes from the pump in the river wall to the water-tanks; also the pipe across the lock to supply the hydraulic jack for operating the river-wall valves.

Putting breech weights on navigable pass wickets.

Clearing out all débris from the lock chamber. it will be used for filling up the land-wall inclosure.

Putting on screens over filling valves in gate recess.

Sitting coping on the lower recess walls and around machinery walls.

Removing coffer-dams.

Owing to the late date at which contracts were awarded, work of construction on the new dams and dikes could not be commenced until the spring of 1885, and the rise in the river during May and June has delayed work considerably.

Merriman Bar, 9 *miles below Pittsburgh.*—Building a dike 2,200 feet long, under contract with J. B. Holbrook, dated October 22, 1884.

Work was started on June 17, 1885, and at the close of the fiscal year the crib-work had been completed for a distance of 170 feet, and filled with stone. No paving had been done.

There have been 18,240 feet B. M. oak timber, 270 cubic yards riprap stone, 485 pounds bolts and spikes expended, and 172 cubic yards of earth have been excavated to secure a good foundation for the root of the dike.

Black's Island, 54 *miles below Pittsburgh.*—Rebuilding old dam to close the right hand chute, under contract with Porter, Tucker & Mahan, November 4, 1884.

Work was begun June 20, 1885, and at the end of the same month 75 feet had been finished, with the exception of paving. The dam is to be 2,650 feet long.

The following materials have been expended: Oak timber, 9,281 feet B. M.; hemlock, 2,920 feet B. M.; stone, 178 cubic yards; bolts and spikes, 734 pounds; and 57 cubic yards of earth excavated to secure a foundation.

Brown's Island, 63 *miles below Pittsburgh.*—Repairing dam under contract with Porter, Tucker & Mahan, dated November 4, 1884.

The dam at Brown's Island, which had been somewhat injured by ice during the winter of 1883 and 1884, was thoroughly repaired by the contractors in the fall of 1884, the following materials being expended on the work: Oak timber, 645 feet B. M.; stone, 461 cubic yards; drift-bolts, 21½ pounds; spikes, 10 pounds; brush, 33.7 cords; gravel, 1,161 cubic yards.

Wheeling Island, 91 *miles below Pittsburgh.*—Building a dam 500 feet long to close the chute behind the island, under contract with I. V. Hoag, jr., dated December 1, 1884. The dam is to be connected with an abutment on each shore 200 feet long, 20 feet high, 19 feet wide at the bottom, and 14 feet on the top.

Work was begun June 1. 1885, by excavating the banks to secure proper foundations for the abutments. At the end of the fiscal year 3,000 cubic yards of earth had been excavated, and a section of timberwork of the abutment on the right bank 19 feet wide, 64 feet long, and 5 feet high had been completed and partially filled with stone.

Materials expended were as follows: Oak timber, 5,190 feet B. M.; riprap stone, 110 cubic yards; bolts, 51,975 pounds.

Captina Island, 107 *miles below Pittsburgh.*—Rebuilding old dam to close the left-hand chute, under contract with J. B. Holbrook, dated October 22, 1884.

Though work was begun here in the early part of June, 1885, nothing could be done during the fiscal year other than to level off the top of the old dam for the reception of the new superstructure. The dam, when completed, will be 1,800 feet long.

Fish Creek Island, 112 *miles below Pittsburgh.*—Rebuilding old dam to close the left-hand chute, under contract with J. B. Holbrook, dated October 22, 1884.

Work commenced June 20, 1885, and at the end of the same month the top of the old work had been leveled off to receive the new superstructure, and 220 cubic yards of earth had been excavated for the foundation of the root of the dam.

Three Brothers, 157 *miles below Pittsburgh.*—Building a dam 2,550 feet long from the West Virginia shore to the head of Middle Brother, thus closing the chutes between West Virginia and Upper Brother, and between Upper Brother and Middle Brother, under contract with J. F. King, dated October 23, 1884.

Work was begun during the week ending June 13, 1885, by excavating 525 cubic yards of earth to secure a good foundation for the root, and by riprapping the bank to prevent scour. At the end of the year the crib-work had been completed for a distance of 609 feet, and about three-fourths filled with stone; 106,915 feet B. M., oak timber, 1,238 cubic yards of stone, and 9,458 pounds of bolts and spikes were expended in the work.

Sand Creek, 220 *miles below Pittsburgh.*—Constructing a dike 1,500 feet long from the West Virginia shore, under contract with J. C. Graham, dated October 27, 1884.

Work was begun May 25, 1885, and at the close of the fiscal year the shore protection was in place, and the dike completed, except the paving, for a distance of 200 feet.

The following materials were used in the construction: Oak timber, 30,084 feet B. M.; riprap stone, 1,744 cubic yards; bolts and spikes, 232 pounds.

Eight Mile Bar, 453 *miles below Pittsburgh.*—Construction of dike from Kentucky shore, 2,300 feet long, under contract with J. J. Shipman, dated November 28, 1884.

Work was begun May 13, and on June 30, 1885, the timber-work was completed for a distance of 550 feet, and filled with stone. One hundred and twenty-five feet were paved.

The following materials were expended: Oak timber, 74,835 feet B. M.; riprap stone, 4,471.7 cubic yards; bolts and spikes, 5,015 pounds; earth excavated for foundation, 198 cubic yards.

Rising Sun, 502 *miles below Pittsburgh.*—Building a dike 2,500 feet long, under contract with Kirk & Company, dated October 22, 1884.

Work was commenced May 4, 1885, and at the end of the year the substructure of the dike, consisting of two rows of piles, 30 feet apart, and partially filled with brush and stone, was completed for a distance of 720 feet. Materials expended: 332 piles, 1,622 cords of brush, 3,024 cubic yards of riprap stone, 7,020 feet B. M., oak timber, and 280 pounds of bolts; earth excavated to secure a good foundation for the root of the dike, 225 cubic yards.

Head of Grand Chain, 943 *miles below Pittsburgh.*—Construction of a dike 3,000 feet long, under contract with C. M. Cole, dated July 12, 1879. At the close of the fiscal year ending June 30, 1884, the substructure of the dike had been built to a length of 2,700 feet, and the superstructure completed to within 30 feet of this distance. Work was resumed in August, 1884, and the dike completed to its total length, 3,000 feet, in November. The contract for this work was let in July, 1879, and it was not finally completed until November, 1884, thus requiring six working seasons. The unusual duration of the period of construction was due to the proximity of the Mississippi River and to the disturbing influence of floods in the latter river. Unless both rivers were low no work could be done, and favorable conditions existed so seldom in both rivers that the average available working season in any one year was only about six weeks.

This dike is a crib-work of squared oak timber filled with stone, and resting on a substructure of cribs of round timber. It is 3,000 feet long, 20 feet wide, and its top is even with the 10-foot stage in the river. There was consumed in its construction—

Round timber	linear feet..	89,13
Square timber	feet B. M..	385,278
Brush	cords..	1,043
Bolts	pounds..	79,443
Stone	cubic yards..	36,839

The cost of this dike, exclusive of inspection, was $50,661.77, which is at the rate of $16.89 per running foot.

Grand Chain, 946 miles from Pittsburgh.—Building a third (intermediate) dike, 3,000 feet long, under contract with I. V. Hoag, jr., dated December 1, 1884.

Work was begun here about the middle of May, but owing to high water, due to back water from the Mississippi River, at the close of the fiscal year only a portion of the shore protection had been put in place.

There had been expended on this work 644 cords of brush and 2,319 cubic yards of stone.

DREDGING.

The river and harbor act did not pass until July 5, 1884, and as the lack of funds had prevented any work of preparation in anticipation of the passage of the bill, much time was unavoidably consumed before the dredges could begin work. The iron hull of the new dredge Oswego had been completed in the spring of 1883, but the machinery, crane, and spuds had not been put into position, and the final completion of this dredge occupied more than two months of the working season, the crews of both dredges being employed for the larger portion of the time. As a consequence, the *Ohio* did not get to work until September 6 and the *Oswego* until September 20. As we are now in possession of two first-class dredge-boats, with iron hulls and cranes, no such delays are like to occur in the future.

Operations for the season were suspended on December 17, at which date the dredges went into winter quarters at Paducah, Ky. Mr. E. J. Carpenter, assistant engineer, was in charge of both dredges.

The following is a statement of the season's work:

Licking River Bar, 466 miles below Pittsburgh.—The improvement at this place consisted in the removal of the point of the rock bar and the loose rock which had been thrown out by the Licking River. It resulted in widening the channel 25 feet.

In making a second cut to secure an additional increase in width, the bar was found to consist of solid rock, and the work was abandoned as too destructive to the dredge machinery.

Excavation made September 6–9, 370 cubic yards. Wreck removed, one.

Cullom's Ripple, 471½ miles below Pittsburgh.—The improvement accomplished at this point was the removal of the stony point on the Ohio side of the channel, which was widened 30 feet. This rocky point was dug away as much as was practicable in 1877 and 1881, but the dredges had to leave a high bluff bank of loose rock, which the little stream emptying into the Ohio at this point subsequently cut down and projected into the river, thus necessitating a partial renewal of the dredging operations.

It is not probable that any further work will be necessary, and the improvement may be considered as permanent.

Excavation made September 10–16, 3,318 cubic yards. Snags removed, three, weighing 4 tons.

Rising Sun Dike, 501½ miles below Pittsburgh.—The work at this place consisted in the removal of the river end of the dike in order to give room for the new channel to be created by a dike from the Indiana shore.

Owing to the low stage of the river, it was found necessary to remove a portion of the gravel bar above and below the dike, and to bank a portion of the spoil in order to obtain water in which to load the scows.

This greatly increased the amount of excavation, and necessitated handling a considerable portion of it twice.

There were 465 linear feet of the dike removed, and all the stone was taken out to a depth of from 7 to 8 feet low water.

Excavation made September 19–October 3, 14,527 cubic yards.

Snags removed, one, weighing 9 tons.

Warsaw Bar, 525 *miles from Pittsburgh.*—The improvement at this place consisted in dredging a channel through the bar, thus deepening and straightening the crossing. Excavation made by the *Ohio*, October 6–17, 15,768.5 cubic yards.

Center Rock, 834½ *miles below Pittsburgh.*—This rock is a mass of indurated clay lying directly in the channel. A portion of the upper surface was removed in 1879 by blasting, but as the area was great (135 feet by 35 feet) and the material soft, it was decided to complete the work by dredging. This was successfully done to a depth of 3 feet below channel depth, thus making a permanent improvement.

Excavation made October 30–November 4, 1,760.3 cubic yards. A snag weighing 2 tons was removed from the channel.

Carrsville, Kentucky, 881 *miles below Pittsburgh.*—Two rocks were removed from the landing November 10, weighing 6.8 tons.

Brooklyn Rock, Illinois, 923 *miles below Pittsburgh.*—This rock lies 250 feet from the shore, in the channel opposite the town of Brooklyn. It appeared at low water as an island, 150 feet long by 45 feet wide, rising to a height of 4 feet; at the level of 1 foot below low water it covered an area of 200 by 100. It was formed of two thicknesses of firmly cemented gravel, 1 to 3 feet thick, resting on a bed of soft gravel.

Before the dredges arrived a blasting party worked on the rock, breaking up the crust with Hercules powder, and the operations of blasting and dredging were continued until the close of the season. It was impossible to break up the crust by dredging alone, as it was cemented by one of the salts of iron, and rang under the hammer almost like metal.

Portions of the wrecks of one steamboat and two barges were found on the rock, one of the latter containing a load of hoop-poles in tangled masses that had to be removed by hand.

When the season's work closed the rock had been wholly removed to a depth of 2 feet below low water, but there still remained a bar of cemented gravel connecting the lower end of the rock with the Illinois shore. Material removed November 28–December 17, 7,620.5 cubic yards.

Jackson Rock, Grand Chain, 944 *miles below Pittsburgh.*—This rock is really a field of rocks, having a total area of about ten acres. It lies off the outer end of the upper dike, right in the channel. All the high points, which constituted what was formerly known as the Jackson Rock, were cut down in 1876, and afterwards in 1879. The increased current caused by the dike developed "breaks" over a large area, and it was hoped that the powerful Ohio River dredges might remove some of the material without preliminary blasting, but the result did not justify our anticipations. All the broken up material was readily removed to a depth of 3 feet below the bed of the river, but the dredges were powerless to handle the rest. It will be necessary to build special blasting boats for service at the Grand Chain, and subsequently to complete the work with the dredges.

Excavation made November 14–25, 718 cubic yards.

Snags removed from the channel, two, weighing 7.6 tons.

The accompanying tables show the amount and cost of all dredging, wrecking, &c., for the season of 1884:

DREDGES IN COMMISSION, 1884.

Time.

Time at work:			
Dredging gravel, &c	days	12	
Dredging rock, &c	do	36	
Wrecking, snagging, &c	do	8	
Total			56
Time lost:			
Traveling	days	21	
Accidents	do	6	
High and low water	do	7	
Sundays	do	14	
Total			48
In commission			104

Work.

Gravel, &c., excavated per day of work	cubic yards	1,717.6
Rock, &c., excavated per day of work	do	659.4
Gravel, &c., excavated during the season	do	20,611.5
Rock, &c., excavated during the season	do	23,756.1
Wrecks removed	number	5
Snags removed	do	7
Snags removed	tons' weight	22.6

Cost.

Equipment:	
Per day in commission	$1 58
Per day of work	2 95
For the season	164 92
Towing:	
Per day in commission	60 52
Per day of work	112 39
For the season	6,294 07
Repairs:	
Per day in commission	2 88
Per day of work	5 36
For the season	300 23
Salaries:	
Per day in commission	44 53
Per day of work	82 67
For the season	4,629 83
Total:	
Per day in commission	109 51
Per day of work	203 37
For the season	11,389 05

DREDGES OUT OF COMMISSION, 1884.

Time.

In ordinary	days	200
Annual spring repairs	do	62
Total		262

Cost.

Salaries in ordinary	$708 57
Towing, fuel, &c	372 50
Total orin dinary	1,081 07

Salaries during annual spring repairs	$2,609	26
Annual spring repairs	2,307	85
Total out of commission	5,998	18
Per day out of commission	22	72
Per day in ordinary	5	40

COST OF WORK, INCLUDING ALL EXPENDITURES DURING 1884.

Dredging gravel, &c	$3,725	84
Dredging rock, &c	11,177	50
Wrecking, snagging, &c	2,483	89
Total	17,387	23
Cost per unit:		
Per cubic yard of gravel, &c., excavated		18
Per cubic yard of rock, &c., excavated		47
Per day in commission	167	18
Per day of work	310	49

1884.	Miles from Pittsburgh.	Place.	Kind of work.	Days of work.	Excavation.				Number wrecks removed.	Snags.		Expenditures.			Total for 1884.
					Cubic yards of gravel, &c.	Cubic yards of rock, &c.	Cubic yards per day of work.	Cost per cubic yard.		Number.	Tons weight.	Gravel, &c.	Rock, &c.	For removing snags, wrecks, &c.	
September	467	Licking River Bar	Loose and solid rock	1½		370. 0	246 7	$1 26					$465 73		$465 73
Do		do	Wrecking	½					1					$155 24	155 24
Do	471½	Cullom's Ripple	Loose rock	2		3, 318. 0	1, 659. 0	19. 3					620 97		620 97
Do		do	Snagging	1						3	4. 0			310 49	310 49
September, October.	501½	Rising Sun Dike	Gravel	3	4, 843. 0		1, 614. 3	19. 2				$931 46			931 46
Do		do	Loose rock	8¾		9, 685. 3	1, 106. 9	28. 7					2, 716 75		2, 716 75
September		do	Snagging	¼						1	9. 0			77 62	77 62
October	525	Warsaw Bar	Gravel, sand, &c	9	15, 768. 5		1, 752. 0	17. 7				2, 794 38			2, 794 38
October, November.	834½	Center Rock	Soft rock, solid	4¾		1, 294. 3	272. 4	1 13. 9					1, 474 81		1, 474 81
November		do	Snagging	¼						1	2. 0			77 62	77 62
Do	881	Carrsville, Ky	Removing shore rocks.	1										310 49	310 49
Do	944	Grand Chain	Dredging rock	3		718. 0	239. 3	1 29. 7					931 46		931 46
Do	943	do	Snagging	1						2	7. 6			310 49	310 49
November, December.	923	Brooklyn Rock	Pudding stone	16		8, 370. 5	523. 2	59. 3					4, 967 78		4, 967 78
Do		do	Wrecking	4					4					1, 241 94	1, 241 94
Total				56	20, 611. 5	23, 756. 1			5	7	22. 6	3, 725 84	11, 177 50	2, 483 89	17, 387 23

SNAG-BOATS.

The snag-boat E. A. Woodruff, under command of Capt. W. H. Christian, began operations August 14, and worked over the river as follows: From Cincinnati to Cullom's Ripple, 5 miles from Cullom's Ripple to Catlettsburg, 157 miles; from Catlettsburg to Bonanza Bar and return, 75 miles from Catlettsburg to Cincinnati, 152 miles; two trips from Cincinnati to Louisville and return, 528 miles; from Cincinnati to Evansville, 272 miles; Evansville to winter quarters at Paducah, 182 miles, arriving at the last named place December 24, 1884. The total distance traveled during the season, including several minor trips made while passing over the river on the general routes above mentioned, was 3,314 miles.

During the season 784 snags were removed, 45 wrecks were either wholly or partly broken up, the remains of five wrecks, previously partly destroyed, were wholly removed, five leaning trees were felled and cut up, and an aggregate of 197 cubic yards of rock were removed from the channel and landings.

Among the obstructions removed may be mentioned a steam-boat hull opposite Wrightsville, Ohio; part of the wreck of the steamer Bonanza opposite Oxleys Stave Company's Landing, Cincinnati; the wreck of the propeller Mamie Glass from the channel opposite Madison, Ind.; the old inlet wall of the Evansville Water Works, the wreck of the steamer Thanauser opposite Cypress Bend, and the wrecks of three model barges, one from Barrett's Coal Landing, Cincinnati, another from O'Neill's Landing, Louisville, and the third from Henderson Bar.

The six largest snags were three sycamore trees taken from the channel near Walnut Bend, one measuring 5 feet in diameter at the butt, and weighing 142.7 tons, another measuring 5 feet 4 inches in diameter at the butt, and weighing 207.8 tons, and the third measuring 6 feet in diameter at the butt, and weighing 203.7 tons; a sycamore tree from the channel about 11 miles below Madison, Ind., measuring 4 feet 10 inches in diameter at the butt, and weighing 143.4 tons; a cottonwood from the channel opposite the head of French Island, measuring 5 feet in diameter at the butt, and weighing 117.7 tons; and a sycamore from the channel below Caseyville, Ky., measuring 5 feet 10 inches in diameter at the butt, and weighing 139.3 tons. The average weight of twenty-five of the largest snags removed was 83.1 tons.

The snag-boat Kwasind, under command of Capt. J. F. Browinski, was borrowed from Capt. J. C. Post, Corps of Engineers, in charge of the improvement of the Kentucky River.

She began operations on October 8 and worked over the upper part of the river as follows: from Cincinnati to Pittsburgh 466 miles; from Pittsburgh to Marietta 171 miles; from Marietta to winter quarters at Carrollton, Ky., 370 miles, arriving at the latter place December 8. The total distance traveled during the time engaged on the upper Ohio, including several trips made while passing over the river as given in general above, was 1,132 miles.

There were removed 243 snags, and four wrecks were either wholly or partly destroyed. The average weight of twenty of the largest snags removed was 12.2 tons.

The total of the snagging work done on the river during 1884, including what was done by the dredges, was therefore as follows:

Snags removed	1,034
New wrecks wholly or partly removed	54
Old wrecks wholly removed	5
Leaning trees felled	5
Cubic yards of rock removed	197

This season's work demonstrated very clearly the necessity of having a snag-boat of lighter draught than the Woodruff. Owing to the lateness of the date on which the Woodruff started out, she was unable to get above the mouth of the Big Sandy, and while working from that point to Cincinnati it was thrice necessary to send the dredge tender to her assistance and deepen the channel by the use of a long scraper attached to a dump-scow. The Woodruff managed to do efficient work below Cincinnati by hiring two lighters and placing all movable articles on them.

After careful study I concluded to recommend that the snag-boat be lengthened 45 feet, and with the approval of the Chief of Engineers proposals were invited for this lengthening, and the contract was awarded to Messrs. Allen & Blaisdell, of Saint Louis, Mo. At this writing the work is nearly completed, and it is expected that the Woodruff will be at work early in August. The present draught of the boat with a full load of coal is 39 inches, and it is thought that she will be lightened up to 31 inches.

REMOVING ROCKS.

Advantage was taken of the extreme low water prevailing in the upper Ohio to remove the rocks which obstruct navigation at various places during medium and low stages of water.

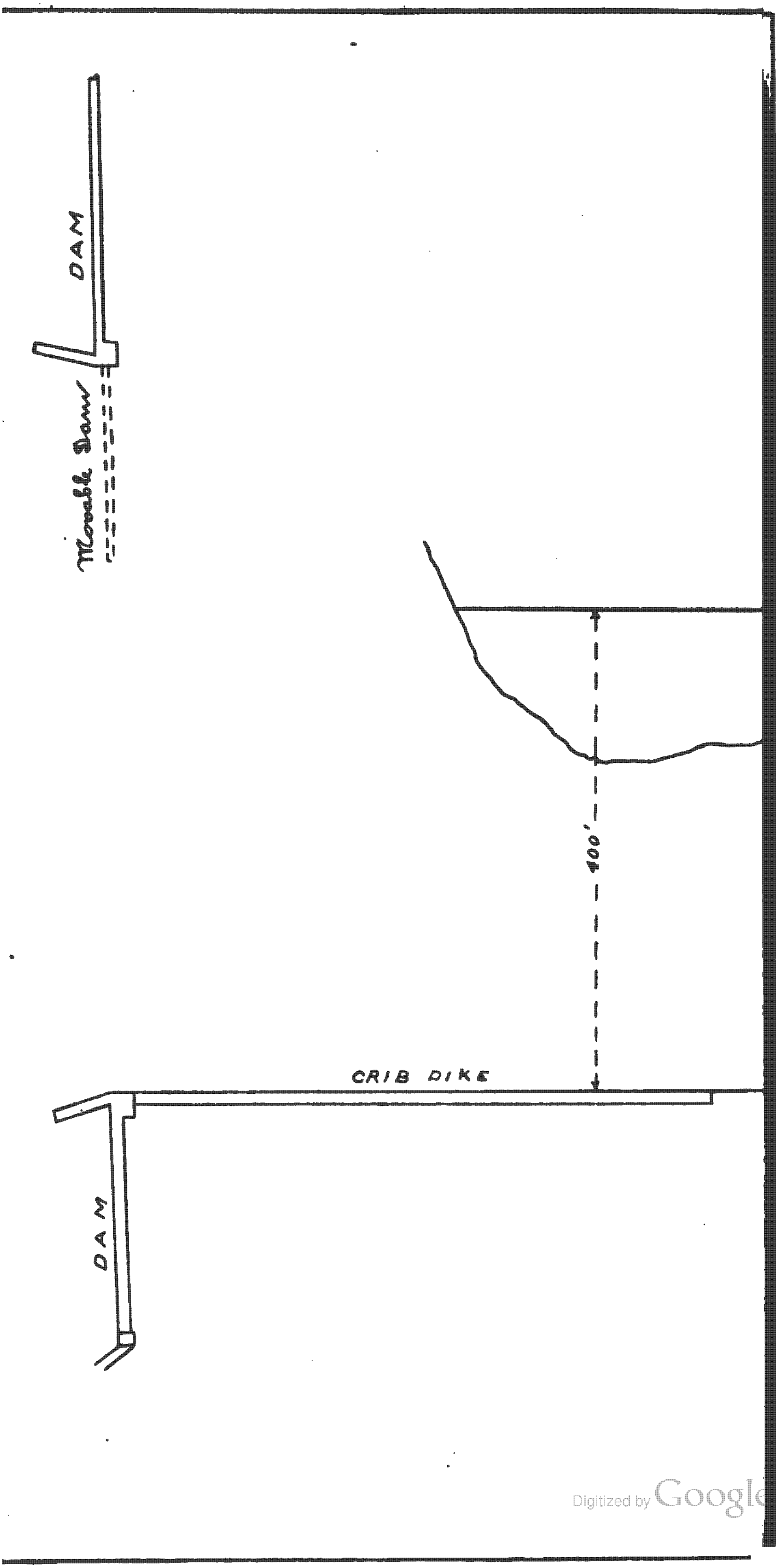
In order to prepare for a change of channel at Merriman, 9 miles below Pittsburgh, 478 rocks, lying on the bar, were broken up by blasting with dynamite. Heavy charges were used in order to break the rocks into fragments so small as not to require removal. Owing to the receipt of a protest from the Pittsburgh Coal Exchange against any change of channel at this locality, the project was abandoned.

Under an informal contract the steamer Iron King, commanded by Capt. J. F. King (with Capt. Marshall Hays as inspector) worked during October and November.

The following table gives a summary of this work:

Miles below Pittsburgh.	Shoals.	Large rocks.	Small rocks.	Estimated weight.	Remarks.
		Number.	*Number.*	*Tons.*	
195	Mustapha Island	73	90	108	
219	Sand Creek	6	none	10	
224	Old Town Bar	3	40	6	
228	Goose Island	4	none	12	
234	Letart Falls	22	none	90	
235	Brinkers Reef	131	110	149	
240	Wolf's Bar	23	110	258	
256	Eight-Mile Island	21	150	34	
266 to 267	Gallipolis Island	56	490	60	Also from channel at head of island, one coal boat and one snag.
274	Raccoon Island	8	150	9	Six snags from channel near foot of island.
278	Crab Creek Bar	none	110	3	Also two snags from channel opposite bar.
282½	Straight Ripple	45	150	107	
	Total	392	1,400	846	

A sudden and remarkably violent flood coming out of the Licking River in the summer of 1882 covered the bar in front of the public landing of Cincinnati with great masses of rock. Some of these were removed in 1883 under a special contract, but so many remained that in


DAM
Movable Dam
400'
CRIB DIKE
DAM

84 a number of men with boats were hired and a large quantity, es-
nated at 1,099 tons, was taken off the bar. This work was carried on
der the direction of Mr. W. F. Williamson.

Under an agreement with George E. Shoop work was begun in Oc-
er and continued through November and a part of December, in re-
ving the masses of rock that obstruct the channel at the Little Chain,
the Heady Rocks, and at the foot of the Grand Chain.

he following amounts were blasted and removed.

	Tons.
le Chain	4,240
dy Rocks	230
t of Grand Chain	231
Total	4,701

IMPROVING THE INDIANA CHUTE, FALLS OF THE OHIO.

he cost of this work is defrayed from allotments for the appropria-
for the improvement of the Ohio River, and it is therefore reported
n item in the general report on that river.

he working season of 1884 proved unusually favorable, and before
osed the Indiana Chute had been very greatly improved. At the
ning of the season there was a channel between the cross-dam and
railroad bridge having a width of 160 feet at the upper end and 200
at the lower, but greatly obstructed by isolated points of rocks.
of these points have been removed and a large portion of the northern
has been blasted out, so that there is now a clear channel of from
to 240 feet in width. In addition to this, a very dangerous mass,
wn as Rubel's Rock, having a length of 165 feet and a width of 43
, and lying in mid-channel just below the railroad bridge, has been
lly removed. A guiding-dike 500 feet long was built on the north
of the chute, in order to cut off a draft to the north and to regu-
ze the flow through the chute.

or details reference is made to the following report of Mr. P. J.
opp, the assistant engineer in charge, and to the accompanying map.

REPORT OF MR. P. J. SCHOPP, ASSISTANT ENGINEER.

e last working season, the fall of 1884, was unusually favorable, the water keep-
t a low stage from September to the first part of December.

ork was commenced on the 27th of August on the southern abutment of the In-
Chute. The abutment was raised to conform to the height of the trestle of
movable dam placed last year. A wing of 50 feet long, resting against the abut-
t and pointing up-stream, was also constructed at this place.

like wing 50 feet long has been carried up-stream from the northern abutment of
hute. These wings give the entrance to the chute a funnel shape and check
ide-currents considerably.

mediately below the northern abutment the current, after leaving the con-
ted entrance through the dam, set strongly towards the Indiana shore, causing a
t deal of trouble to pilots taking vessels over the falls.

remedy this a guiding-dike was constructed at right angles to the dam, consist-
f a stone-filled crib 500 feet long from the face of the cross-dam, with a width of
et and an average height of 6 feet. This arrangement proves very beneficial,
ng greater security to passing vessels.

e work of removing dangerous rock-reefs in the Indiana Chute was continued.
een of these reefs were isolated patches of rock, some of them almost in mid-
nel. Prominent among them was the remainder of the much-dreaded Rubel's
, a reef 165 feet long and 43 feet average width, composed of a number of
ted patches of flinty limestone from 4 to 5 feet above the bed of the channel.
reef was situated below the railroad bridge, in an exceedingly strong current,
ing the placing of breakwaters and the removal of the rock very dangerous and
me.

Besides the isolated reefs, a large part of what is called the right-hand reef has been removed, giving to the former channel an additional width of 80 feet at the upper end and 50 feet at the lower, the total width at this place being 250 feet, where originally there was only a width of 45 feet.

The beneficial result was shown last April, when at a stage of 12 feet in the canal (the locks being closed) coal-boats drawing from 7½ to 8 feet passed through the channel three abreast. This was never attempted before.

During the season's work ending December 6 3,763 cubic yards of rock were removed at a cost of $14,281.65, or $3.79 per cubic yard.

Part of the blasted rock was used to fill the cribs of the breakwater, thus serving a double purpose.

The accompanying chart shows the work done in the Indiana Chute during the season of 1884. It also shows that much remains to be done to give safety to navigation. The channel is yet crooked, and too narrow to pass a full tow without breaking it at a 11½ to 12-foot stage of water upon our gauge. In the space between the cross-dam and the railroad bridge the navigable channel should be at least as wide as the large span of the bridge. To accomplish that for the benefit of commerce would require an approximate outlay of $150,000, of which $30,000 could be profitably expended in the next fiscal year.

The falls were navigable only a short time in comparison with former years—fifty-six days for descending and fourteen days for ascending boats. During that period 803 vessels passed, representing an under tonnage of 256,015 tons.

Among the cargoes were 5,873,000 bushels of coal, 1,200 tons of iron-ore, besides less bulky merchandise.

Tables showing in a condensed form the business done on the falls will be found in the report on the Louisville and Portland Canal. For this information I am under obligations to the local pilots who furnished it.

It is proposed to continue the removal of the northern reef up to the line indicated on the chart, and subsequently to cut off the southern reef as shown by a similar line. When the work is completed there will be a smooth and regular channel through the upper part of the Indiana Chute, varying in width from 400 feet at the upper end to 365 feet at the lower. It is estimated that $150,000 will be required to complete the work thus outlined, and that $30,000 could be profitably expended during the next fiscal year.

CONSTRUCTION OF LEVEE AT JEFFERSONVILLE, INDIANA.

The river and harbor act of July 5, 1884, under the item of "Improving Ohio River," contained a provision that $50,000, or so much thereof as may be necessary, shall be expended "for the improvement of the navigation of the river at Jeffersonville, and the protection of the Government property."

With the approval of the Chief of Engineers it was decided to build a levee along the river front of the town to a height of 2 feet above the high water of 1884, and bids for this work were invited by advertisement dated March 17, 1885, and were opened on April 30, 1885, with the following result:

Abstract of proposals for constructing levee at Jeffersonville, Ind.

No.	Bidders.	Embankment, per cubic yard.	Stone masonry, per cubic yard.	Brick masonry, per cubic yard.	Concrete, per cubic yard.	Excavations for flood-gate well, per cubic yard.	Wrought-iron work, per pound.	Cast-iron work, per pound.	Reconstruction of streets, per square.	Reconstruction of sidewalks, per square.	Reconstruction of gutters, per square.	Resetting curbing, per linear yard.	Block pavement in alley, per square.	Paving slopes, per square.	Total cost.
1	Joseph Coyne	$0 58	$3 10	$7 00	$3 25	$0 40	$0 08	$0 07⅛	$6 25	$3 90	$12 50	$0 80	$11 90	$5 25	$32,581 19
2	John B. Holbrook	64	3 65	8 15	5 00	40	08	08	4 60	3 90	3 70	1 50	3 50	3 50	32,928 92
3	P. H. Sweeney & Bros	57	5 75	5 75	3 25	50	09	07½	6 50	5 00	5 50	90	14 00	5 50	33,003 95
4	Richler, Twiname & Co	57	7 00	7 50	7 00	75	10	07⅛	9 00	8 00	5 00	90	7 50	7 30	33,124 10
5	Neal Norton	60	4 50	7 00	5 00	35	11	07⅛	7 00	4 00	6 00	50	12 00	6 00	33,819 67
6	James Keigwin	57⅛	4 25	8 00	3 50	40	10	07⅛	5 00	4 00	12 00	15	16 00	10 00	34,297 82
7	Arnold Hollerback	60	5 00	10 00	6 00	50	10	07⅛	12 00	12 00	14 20	45	14 20	10 80	37,447 09
8	James Burke	66	6 50	6 25	4 00	50	08	08	6 00	5 50	8 00	50	14 00	8 00	37,623 52
9	F. D. Heustis	67	5 70	6 50	2 50	45	06	09	6 00	5 00	11 00	80	14 00	8 00	38,111 95
10	Martin J. Brannon	59	4 85	8 00	5 50	50	20	08	11 75	5 50	16 50	38	16 50	16 00	38,235 11
11	Porter, Tucker & Mahan	68⅔	6 00	8 00	5 00	25	15	10	5 00	5 00	10 00	60	10 00	10 00	38,559 56
12	Bray & Davidson	67	10 00	9 00	5 00	36	10	07⅛	8 00	5 00	12 00	1 65	12 00	7 50	38,907 66
13	G. W. Boyer & Co	74	3 95	9 75	4 25	60	10	09	10 50	6 00	15 40	90	16 25	12 00	43,771 60
14	Shanks & Jameson	80	3 40	9 45	6 00	50	09	08	9 50	5 75	19 00	1 35	19 00	19 00	48,437 04
15	C. C. Murphy	87	9 37	14 25	5 75	35	06	08⅛	8 35	7 75	17 00	95	17 00	15 00	51,116 17

The contract was awarded to Joseph Coyne, of Jeffersonville, Ind., and was executed under date of May 8, 1885. It provides that the levee shall be completed by January 1, 1886.

Work was begun under the contract on the 1st of June, 1885, and at the end of the fiscal year 1,940 cubic yards of embankment had been made on a portion of the levee lying between Walnut street and Meigs avenue, raising the same for a distance of 600 feet to an average height of 12 feet. The levee, when completed, will have a total length of 5,725 feet, and will contain about 43,400 cubic yards of embankment.

SPECIAL SURVEYS.

The following special surveys were made during the year:

Locality.	Miles below Pittsburgh.	Locality.	Miles below Pittsburgh.
Duff's	8	Five Mile Bar	455
Merriman Bar	9	Laughery's Island	497
Clusters	51	Warsaw Bar	524
Opossum Creek	118	Vevay Bar	533
Fishing Creek Bar	127	Locust Bar	543
Williamson Island	133	Hoagland Bar	549
Mill Creek Island Bar	141	Blue River Island Bar	654
Collins's Ripple	143	Chenault's Reach	692
Marietta Island	167	Evansville Bar	782
Muskingum Island	173	Henderson Bar	798
Blennerhassett's Island	184	Slim Island	822
Newbury Bar	193	Pryor's Island	888
Belleville Island	202	Sisters	896
Gallipolis Island	266	Cowper's Bar	905
Conconneque	364		

ESTIMATE.

The following table gives a list of the more prominent bars on the Ohio River requiring improvement, and the estimated cost of the necessary work:

Miles below Pittsburgh.	Locality.	Kind of work.	Estimated cost.
5	Head of Neville Island	Dam	$7,368
8	Duff's	Dike	19,620
51	Clusters	Dam	44,208
84	Twins	Repair of dam	36,840
118	Opossum Creek	Dike	25,560
127	Fishing Creek Bar	do	22,140
133	Williamson Island	Repair of dam	28,244
141	Mill Creek Island Bar	Dike	22,104
143	Collins's Ripple	do	17,658
167	Marietta Island	Repair of dam	12,280
173	Muskingum Island	do	46,664
184	Blennerhassett's Island	do	19,648
214	Buffington Island	do	24,560
255	Eight Mile Island	Dam and dike	28,244
302	Guyandotte	Dike	26,450
352	Bonanza Bar	do	33,000
412	Charleston Bar	do	21,582
424	Augusta Bar	do	24,525
430	Snag Bar	do	21,563
485	Medoc	do	69,520
497	Laughery's Island	do	50,148
508	Gunpowder	do	37,000
524	Warsaw	Repair of dike	25,392
538	Craig's Bar	Dike	26,450
553	Madison Bar	do	72,000
581	Grassy Flats	do	69,650

Miles below Pittsburgh.	Locality.	Kind of work.	Estimated cost.
654	Blue River Island Bar	Dike	$83, 580
682	Flint Island	do	79, 000
692	Chenault's Reach	Two dikes	167, 180
760	French Island	Repair of dike	42, 980
764	Scuffletown Bar	Dike	83, 590
782	Evansville Bar	Repair of dike	31, 363
793	Henderson	Repair and extension of dike	57, 439
822	Slim Island	Dam	33, 482
846	Shawneetown Bar	Two dikes	156, 016
861	Caseyville Bar	Dike	84, 000
870	Walker's Bar	do	139, 300
896	Sisters	do	139, 300
905	Cowper's Bar	do	111, 440
	Total		2, 041, 057

In addition to the above, works of improvement are required at—

Locality.	Miles below Pittsburgh.
Newbury Bar	193
Belleville Island	202
Gallipolis Island	266
Conconneque	364
Five-mile Bar	455

Detailed surveys of these localities have been made, but the maps are not yet plotted and estimates of cost cannot now be submitted.

At Marietta Island, Blennerhassetts Island, Buffington Island, Warsaw, French Island, Evansville, and Henderson Island, it is proposed to cap existing dams and dikes with crib superstructures filled with stone, as experience has demonstrated that this is the only method thus far known of keeping these works up to the height required for effective action on the bars. All structures hitherto built with cappings of riprap stone have been cut down by ice and drift, and for this reason all recent works have been completed with crib superstructures. The remedy has proved perfectly effective.

As the projected works are independent of one another, all of them could be in progress at one time, and therefore the whole sum named could be expended in one fiscal year. As the amount is so great, I have concluded to limit my estimate for dams and dikes for the next fiscal year to $888,000.

In building the Davis Island Dam the engineer in charge had two objects in view. One was to improve the harbor of Pittsburgh, and the other, and more important object, was to demonstrate the only way of radically improving the navigation of the Ohio River. It was not to be expected that one movable dam would have any appreciable influence on navigation, but it could prove beyond cavil or misapprehension what a movable dam could do, how far it was adapted to the uses of the craft that navigate the Ohio, and how much it would cost.

By the middle of August the Davis Island Dam will be in operation. It is hoped and expected that the work will be so successful as to lead to a demand for others like it, but it has been thought best not to press the matter until the pioneer dam has fully demonstrated its usefulness.

This report, therefore, contains no estimate for any extension of the system.

The estimate for the improvement of the Ohio River is as follows:

Dams and dikes	$888,000
Falls of the Ohio	30,000
Snagging	25,000
Dredging	16,500
Removing rocks	5,000
Office expenses, inspection, engineering, and contingencies	35,500
Total	1,000,000

Money statement.

July 1, 1884, amount available		$19,082 00
Amount appropriated by act approved July 5, 1884		600,000 00
		619,082 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$179,260 10	
July 1, 1885, outstanding liabilities	44,061 71	
		223,321 81
July 1, 1885, amount available		395,760 19
Amount that can be profitably expended in fiscal year ending June 30, 1887		1,000,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCE OF THE OHIO RIVER.

As there are no duties on inland commerce and no laws requiring reports of cargoes, it is impracticable to procure accurate statistics of the commerce of any Western river. The following reports of coal shipments from Pittsburgh and of the leading shipments of Cincinnati are the only statistics procurable, except those of vessels passing the falls of the Ohio, which are given in the report on the Louisville and Portland Canal.

Coal shipments from Pittsburgh by Ohio River during the fiscal year ending June 30, 1885.

[Prepared by Captain William Evans.]

Month.	To Cincinnati.					To Louisville.				
	Trips.	Coal-boats.	Coal-barges.	Fuel-flats.	Bushels.	Trips.	Coal-boats.	Coal-barges.	Fuel-flats.	Bushels.
1884.										
July	5	......	54	3	682,000	18	1	183	7	2,262,000
August	......	......	......	......	......	......	......	......	......	......
September	......	......	......	......	......	......	......	......	......	......
October	......	......	......	......	......	......	......	......	......	......
November	......	......	......	......	......	......	......	......	......	......
December	39	177	251	14	7,198,000	41	14	433	6	5,351,000
1885.										
January	45	225	152	42	7,697,000	17	6	156	......	2,136,000
February	......	...	......	......	......	......	......	......	......	......
March	2	2	18	......	264,000	4	......	38	2	470,000
April	73	304	445	23	12,846,000	61	23	629	23	8,237,000
May	31	4	360	20	4,523,000	42	14	452	4	5,566,000
June	41	197	197	41	7,350,000	22	15	228	15	3,253,000
Total	236	909	1,477	143	40,560,000	205	73	2,119	57	27,275,000
Grand total	......	......	......	......	......	......	......	......	......	67,835,000

Colonel Sidney D. Maxwell, superintendent of the Cincinnati Chamber of Commerce, in his last annual report gives a full exhibit of the river commerce of Cincinnati, from which the following tables, showing the principal items, have been compiled:

River commerce of Cincinnati for the year ending August 31, 1884.

Articles.	Receipts.	Shipments.			
		To New Orleans.	To other down-river ports.	To up-river ports.	Total.
Ale, beer, and porter ... barrels		1, 350	2, 104	11, 978	15, 432
Apples, green ... do	44, 449	375	3, 205	1, 380	4, 960
Beef ... pounds		69, 100	51, 790	6, 940	127, 830
Boots and shoes ... cases		847	20, 562	10, 193	31, 602
Broom-corn ... pounds		648	2, 374	74, 400	77, 422
Butter ... barrels			25		25
Butter ... tubs and firkins, &c		1, 388	3, 779	80	5, 247
Candles ... boxes		7, 165	2, 452	1, 692	11, 309
Cattle ... head	12, 497	169	355	394	918
Castings ... tons		588	810	261	1, 659
Cement and plaster ... barrels		50	764	7, 832	8, 646
Coffee ... bags		56	8, 672	13, 339	22, 067
Cooperage ... pieces		11, 786	2, 149	1, 102	15, 037
Corn ... bushels	139, 455	150	14, 733	46, 377	61, 260
Cotton ... bales	21, 782		135	908	1, 043
Flour ... barrels	13, 185	623	10, 594	31, 534	42, 751
Furniture ... packages		21, 439	17, 008	18, 867	57, 314
Glass, window ... boxes		1, 091	4, 755	1, 614	7, 460
Glassware ... packages		10, 261	41, 746	5, 125	57, 132
Hardware ... do		2, 591	46, 342	23, 444	72, 377
Hay ... bales		499	428	194	1, 121
Hog products:					
Bacon ... pounds		18, 800	732, 492	3, 310, 344	4, 061, 636
Bulk, loose ... pounds		7, 990	30, 980	406, 670	445, 640
Bulk, in boxes ... do		6, 500	42, 000	194, 500	243, 000
Hams ... do		25, 100	191, 720	457, 470	674, 290
Lard, in tierces ... do		59, 210	194, 530	708, 447	962, 187
Lard, in kegs ... do		2, 790	3, 461	10, 070	16, 325
Pork ... barrels		1, 421	205	463	2, 089
Hogs ...	61, 195		88	2, 232	2, 320
Horses ... head		100	390	1, 197	1, 687
Iron and steel ... tons		1, 743	7, 703	655	10, 101
Iron, manufactured ... do	11, 498				
Iron, pig ... do	28, 843		638	1, 621	2, 259
Lead, white ... kegs		74	13, 072	15, 957	29, 103
Malt ... bushels			19, 867	5, 112	24, 979
Manufactures ... pieces		1, 362	1, 761	819	3, 942
Merchandise, sundry ... tons		3, 759	14, 242	11, 050	29, 051
Molasses ... barrels	26, 973	14	1, 192	8, 923	10. 129
Nails ... kegs	366, 088	56, 647	146, 078	1, 582	204, 307
Oats ... bushels		100	2, 841	12, 263	15, 204
Oil ... barrels	38, 892	2, 368	12, 679	5, 361	20, 408
Peanuts ... bags	88, 104	135	524	3, 789	4, 448
Petroleum ... barrels	10, 126	1, 695	5, 564	1, 022	8, 281
Potatoes ... bags and barrels	42, 945	3, 165	1, 653	7, 288	12, 106
Salt ... barrels	169, 660	400	40, 889	626	41, 915
Seeds, grass ... bags		3	1, 979	9, 097	11, 079
Sheep ... head	28, 527	100	479	315	894
Soap ... boxes		26, 322	32, 915	28, 739	87, 976
Starch ... do		26, 037	14, 379	9, 756	50, 172
Sugar ... hogsheads	3, 879	1	43	149	193
Do ... barrels	8, 237	162	6, 901	9, 784	16, 847
Tobacco, leaf ... hogsheads	28, 635	39	1, 938	1, 995	3, 972
Do ... cases and boxes		10	1, 432	670	2, 112
Tobacco, manufactured ... packages		163	5, 982	8, 652	14, 797
Wheat ... bushels	142, 512		10, 592	11, 071	21, 663
Whisky ... barrels	43, 106	4, 413	12, 629	9. 999	27, 041
Wool ... bales			406	1, 065	1, 471

Schedule of rates on flour per barrel, by rail and river, from Cincinnati, during the calendar year 1884.

How transported.	To Pittsburgh.	To Louisville.	To New Orleans.
	Cents.	*Cents.*	*Cents.*
By rail ...	18 to 31	15	56 to 65
By river ...	20 to 25	15	48 to 55

The following tables, compiled from Colonel Maxwell's report, furnish some additional information regarding the steamboat interests of Cincinnati:

Steamboats and barges.

Items.	1879-'80.		1880-'81.		1881-'82.		1882-'83.		1883-'84.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
Steanboats landing at Cincinnati	234	62, 044	206	58, 153	214	78, 793	217	75, 344	188	68, 312
Steamboats built at Cincinnati	10	3, 351	7	1, 169	8	1, 299	7	1, 857	4	1, 288
Model barges built at Cincinnati	6	2, 219	8	10, 067	5	4, 200	5	3, 100	......	....

Departures and arrivals.

Ports of departure and destination.	1879-'80.		1880-'81.		1881-'82.		1882-'83.		1883-'84.	
	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.	Departures.	Arrivals.	Departures.
From New Orleans	103	....	86	....	68	....	94	....	63	.....
For New Orleans	....	116	....	90	......	79	....	95	....	70
From Pittsburgh	182	....	164	....	169	....	147	....	114	....
For Pittsburgh	.....	182	....	164	....	164	....	143	....	111
From Saint Louis	93	....	42	....	38	....	10	....	2	....
For Saint Louis	....	94	....	48	....	45	....	16	....	3
From other ports	2, 785	....	2, 346	....	2, 461	....	2, 089	....	1, 991	....
For other ports	....	2, 780	....	2, 331	....	2, 451	....	2, 075	....	1, 978
Totals	3, 163	3, 172	2, 638	2, 633	2, 736	2, 739	2, 340	2, 329	2, 170	2, 162

For further statistics of the Ohio River commerce, see table in report on Louisville and Portland Canal, giving the number and tonnage of vessels that have passed the Falls of the Ohio during the last five years.

C C 2.

OPERATING AND KEEPING IN REPAIR THE MOVABLE DAM AT DAVIS ISLAND, OHIO RIVER.

This work will be completed some time in August, 1885, and its maintenance will then constitute a charge upon the Treasury. It is proposed to have a permanent force of four men, and to hire temporarily such additional force as may be required during the work of raising or lowering the dam, the whole force to be under the control of a resident engineer.

It is essential that the management of a work of this character should be under the direct charge of a civil engineer, and the fact that there is but one such work on the Ohio River does not lessen the necessity. The same engineer could and should control all the movable dams that may be built between Pittsburgh and Wheeling, but as long as there is but one such dam, his services will have to be a charge against that one.

ESTIMATE FOR 1885-'86.

Resident engineer	$2,100
Lock-keeper	840
Assistant lock-keeper	720
Two lock-hands	960
Extra labor	300
Oil and coal	205
Telephone	240
Repairs and contingencies	500
Total	5,865

ESTIMATE FOR 1886-'87.

Resident engineer	$2,100
Lock-keeper	840
Assistant lock-keeper	720
Two lock-hands	960
Extra labor	300
Oil and coal	205
Telephone	240
Repairs and contingencies	500
Total	5,865

C C 3.

OPERATING AND CARE OF LOUISVILLE AND PORTLAND CANAL.

During the year just ended the canal was closed by high water for eight days, and by ice for twenty-one days, making a total of twenty-nine days during which the canal was not available for navigation.

The following contracts were made during the year:

By advertisement dated May 24, 1884, proposals were invited for constructing an iron dredge hull for use at the Louisville and Portland Canal.

The following bids were received and opened on September 2, 1884:

Proposals for iron dredge hull.

No.	Bidders.	Price.
1	Burnet & Co	*$13,026 98
2	D. W. C. Carroll & Co., limited	14,700 00
3	Rees & Thorn	15,000 00
4	Allen & Blaisdell	15,880 00
5	Queen City Bridge and Steam Forging Company	21,000 00

* Accepted.

Contract was awarded to Burnet & Co., of Cincinnati, Ohio, and executed under date of September 30, 1884.

By advertisement dated May 15, 1885, proposals were invited for furnishing coal for use at the canal during the fiscal year ending June 30, 1885.

The following bids were received and opened June 17, 1885:

Proposals for coal.

No.	Bidders.	9,900 bushels Youghiogneny coal, per bushel.	22,500 bushels Ohio River or Kanawha coal, per bushel.	Aggregate of bids.
		Cents.	*Cents.*	
1	Austin H. Dugan	10½	7½	$2,727
2	Byrne & Speed	11	9	3,104

Contract was awarded to Mr. Austin H. Dugan, and executed under date of June 29, 1885.

During the autumn the new locks were closed, and the middle miter-sill, which was in bad condition, was removed and rebuilt, a little over two months being required for this work. The difficulty with this miter-sill was due to the great width of the middle gates, which caused an excess of underpressure during certain stages. To prevent accidents in the future, I have directed that these gates be permanently loaded with iron weights placed on the arms near the toe-posts.

Water-pipes for removing the deposits of floods have been placed on each side of the new locks, and the work of collimation in the ravine below the lower guiding wall has been continued with gratifying success.

A new and substantial cottage has been built for the attendant at the Eighteenth Street Bridge.

The usual repairs have been made on the old dredges and a new iron dredge is under construction at Cincinnati. The hull should have been furnished in March, but the bad management and lack of experience of the contractors and financial difficulties in which they became involved has delayed the work so that the hull is not yet completed. The other old wooden dredge should be renewed during the present fiscal year, and a new dredge tender should be built. The present tender is worn out and has insufficient power for the work required of her.

New and more stringent regulations have been adapted for the management of the canal, and the friction and confusion incident to the passage of coal fleets have been notably reduced.

The basin above the new locks is so far away as to seriously delay the passage of fleets. As matters are now arranged, ascending boats must not only pass through the locks, but must also travel over a space of 800 feet before they reach the basin, and no descending vessel can move until this space has been traversed by the other vessel. If the existing basin were carried down as far as the head of the new locks the number of possible lockages in a given period would be considerably increased. The cost of this enlargement is estimated at $120,000, and it is proposed to divide it between two years. One-half of this amount is therefore added to the estimate of 1886–'87.

There no longer seems to be any necessity for a high-water lock, and the proposed lengthening of the basin above the new locks is a virtual abandonment of the scheme.

Hitherto in reporting lockages it had been customary to report each passage through the locks as one lockage, regardless of the fact that in low water every passage required two lockages. The tables for the fiscal year just ended have been made to show the actual number of lockages.

A table has been prepared showing the total amount of commerce that passed the Falls of the Ohio by canal and river during the last five years. This table gives the best available data on the mooted question, whether river commerce is increasing or decreasing. Unfortunately our record of boats passing the falls is limited to the last five years, and hence the table cannot go back of July, 1880. The increase during the past fiscal year in the number of boats that ascended the falls is doubtless, in some measure, due to the recent improvements in the Middle and Indiana chutes.

For further details reference is made to the annexed report of Mr. P. J. Schopp, superintendent of the canal.

REPORT OF MR. P. J. SCHOPP, SUPERINTENDENT OF LOUISVILLE AND PORTLAND CANAL.

LOUISVILLE, KY., *July* 1, 1885.

SIR: I have the honor to submit herewith my annual report upon operating and care of Louisville and Portland Canal for the fiscal year ending June 30, 1885.

The canal was in operation during the year 336 days, closed by ice 21 days, and by high water 8 days. The ice reached a thickness of 11 inches.

On account of necessary and extensive repairs the new locks were closed on August 12, and opened again October 20.

While the new locks were being repaired the old locks were used to pass boats, and navigation was not interrupted.

During operation of the canal 4,886 vessels, representing an undertonnage of 1,217,231 tons, and carrying 24,422,052 bushels of coal, 18,808 tons of iron ore, and 84,510 bushels of salt, besides miscellaneous freights, passed through the canal.

The Ohio Valley was not visited by a flood in this year, and consequently the canal was used for a longer period than in the preceding years.

Some slight damages done by running drift and ice on the guiding-dike were repaired.

The wooden revetment along the south bank between Eighth and Ninth streets, being rotten and dangerous to navigation, was repaired to such an extent as circumstances permitted.

The iron swing-bridge over the canal at Eighteenth street underwent a thorough overhauling, and after repairs was also painted.

A two-story cottage, the lower story being of brick and the upper one a frame structure, was built on the north bank of the canal, a short distance from the Eighteenth Street Bridge, for the use of the bridge-tender.

A small force of stone-cutters has been engaged to cut projecting parts, dangerous to passing boats, from the canal retaining wall.

Damages done by passing boats to the old retaining-wall on the north side were repaired.

No repairs were needed on the dry-dock and none on the old locks. The latter were of great use during the two months in which the new locks were closed for repairs, and without them navigation would have been interrupted for that time.

At the new locks the middle miter-sill, which gave so much trouble in preceding years, was removed and rebuilt in the most substantial manner. The bed-rock upon which the old sill rested, and which was uneven and cracked by previous blasting, was removed to the level of the bottom of the lower lock-chamber, and the excavated space was built up with carefully dressed dimension-stones. Strong iron anchor-bolts were passed through these stones to the bottom, where they were firmly anchored. On top these bolts received the wooden miter-sill. Since the work has been completed no further trouble has been experienced.

The removal of heavy deposits left by high water on the locks required time and extra expenses. To avoid both, two large pumps were placed at the middle gates, one on each side, with pipe connection reaching up and down the locks. By these means a stream of water is forced upon the deposit and the same quickly removed.

No repairs were needed on the shops and tool-houses, with the exception of the furnace under the stationary-engine boiler in the machine-shop, which had to be rebuilt.

No outside repairs were done on the canal office and dwelling for the assistant superintendent, but the interior of the latter building was papered, and in both buildings ventilating-pipes were placed.

Upon the dam in the ravine below the locks another section or tier was placed, to lessen the current of the cutting stream.

This additional dam, 6 feet high, is now also filled up and ready for another tier, which will be built during the present season.

Dredge No. 1 one received a new crane, and No. 2 a rear spud hoisting apparatus. Both dredges, getting old, needed frequent repairs.

A contract has been made for a new iron dredge, which is now being constructed.

A second new iron dredge should be built in the coming fiscal year, as the wooden hulls of both dredges are no longer sound.

The dredge-tender Walker Morris underwent many repairs, the principal one being a new steam-cylinder for her engines. The old one cracked through its entire length. She also received two mud-drums. Her hull is getting weak now, and I recommend that the suggestion in my report of last year be carried out, and an entire new boat be contracted for.

Work has been commenced to replace the four rotten mud-scows by new ones.

One new scow has been completed, and the timber for a second one is on hand.

During a coal run (when coal-tows pass through the locks), which may happen half a dozen times during the year, and last each time from a week to ten days, complaints are frequently made [illegible] single packets on account of delays, the coal-tows occupying the canal and locks. Under existing circumstances these delays are unavoidable, as the available space in locks and canal, if occupied by one vessel, cannot well be occupied by another. The space above the locks for a distance of 800 feet is only 90 feet wide, 10 feet wider than the locks. This width admits only one vessel, and when occupied by coal-boats a packet cannot reach the locks, but must wait until all the vessels in the narrow space have passed. The evil could be somewhat remedied by widening the space above the locks, so as to let a packet come around a coal-tow. If widened, it should be done with a view to serve as an approach to a prospective new lock parallel to the present one. The only radical remedy, however, is such a lock in connection with the widening of the canal through its entire length.

I submit an item of cost in my estimate for the fiscal year 1886–'87 for widening the approach to the present locks. No changes have been made in the number (forty) of regular employés. When the service requires it, extra labor is hired.

Charges for extra work of dredges, use of dry-dock, towing, and pumping are the same as last year. An addition has been made in rent on canal grounds occupied by the Louisville Cement Company, paying $30 per year, and the Union Cement Company, paying $5 per year. The receipts from extra work of dredging, use of dry-dock, towing, pumping, and rent amount to $831.69.

The total expenditures during the fiscal year were $72,368.58, of which $12,216.91 were expended for improvements.

Estimates for the fiscal years 1885–'86 and 1886–'87 are herewith submitted.

Tables prepared from records kept in this office are also submitted for comparison with those of former years.

Very respectfully, your obedient servant,

PHIL. J. SCHOPP,
Superintendent of Louisville and Portland Canal.

Lieut. Col. WILLIAM E. MERRILL,
Corps of Engineers, U. S. A.

Financial statement for fiscal year ending June 30, 1885.

Receipts.	Amount.	Expenditures.	Amount.
Rents	$37 09	Office and general administration	$10,004 85
Dry-dock	739 60	Canal and locks	36,889 27
Dredging	55 00	Dredging	13,258 05
		New dredging plant	8,040 22
		Improvements	4,176 69
Total	831 69	Total	72,368 58

The total cost of passing boats and freight through the canal during the past fiscal year, including all expenditures except for improvements and new plant, which are not properly chargeable to current expenses, was:

Per lockage	$19 96
Per boat	12 31
Per ton	05

Cost, exclusive of improvements, new plant, and dredging:

Per lockage	$16 23
Per boat	9 60
Per ton	04

APPROXIMATE ESTIMATE OF EXPENDITURES ON THE LOUISVILLE AND PORTLAND CANAL, KENTUCKY, FOR THE FISCAL YEAR ENDING JUNE 30, 1886.

Regular pay-rolls	$31,140
Extra labor	5,000
Miscellaneous, fuel, oil, &c	4,700
General repairs	3,000
New dredge-tender	18,000
New iron dredge	25,000
Contingencies	5,000
Total	91,840

APPROXIMATE ESTIMATE OF EXPENDITURES ON THE LOUISVILLE AND PORTLAND CANAL, KENTUCKY, FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

Regular pay-rolls	$31,140
Extra labor	5,000
Miscellaneous, fuel, oil, &c	4,700
General repairs	3,000
Widening approach to the new locks	60,000
Contingencies	5,000
Total	108,840

Detailed statement of expenditures, operating and care of the Louisville and Portland Canal for fiscal year ending June 30, 1885.

Month.	Office and general administration.				Canal and locks.			
	Salaries.	Supplies.	Miscellaneous.	Total.	Labor.	Supplies.	Repairs.	Total.
1884.								
July	$580 00	$13 93	$201 99	$795 92	$1,180	$230 12	$754 61	$2,164 73
August	580 00	....	18 00	598 00	1,180	873 28	6,761 70	8,314 98
September	759 17	....	17 60	776 77	1,180	90 42	6,876 87	8,147 29
October	705 00	20 65	127 84	853 49	1,180	54 11	2,874 38	4,108 49
November	580 00	5 00	53 84	638 84	1,180	156 60	626 87	1,963 47
December	830 00	....	....	830 00	1,180	155 18	271 91	1,607 09
1885.								
January	705 00	44 33	103 50	852 83	1,180	114 56	61 20	1,255 76
February	705 00	1 20	73 00	779 20	1,180	133 81	115 47	1,429 28
March	705 00	....	64 40	769 40	1,180	214 47	....	1,394 47
April	967 50	10 40	....	977 90	1,180	117 48	799 95	2,097 43
May	1,046 67	2 48	....	1,049 15	1,180	447 69	508 98	2,136 67
June	1,046 67	....	36 18	1,082 85	1,180	261 49	728 12	2,169 61
Totals	9,210 01	97 99	696 35	10,004 85	14,160	2,349 21	20,380 00	36,889 27

Month.	Dredging.				New dredging plant.	Improvements.
	Labor.	Supplies.	Repairs.	Total.		
1884.						
July	$835 00	$191 31	$380 92	$1,407 23	....	....
August	835 00	204 60	25 35	1,064 95	....	$1,100 00
September	835 00	120 00	121 92	1,076 92	....	1,200 00
October	835 00	121 30	85 69	1,041 99	....	75 00
November	835 00	254 38	18 40	1,107 78	....	44 32
December	835 67	160 00	38 07	1,033 74	....	....
1885.						
January	835 00	180 52	160 82	1,176 34	....	....
February	835 00	....	63 83	888 83	$2,702 02	229 05
March	835 00	133 40	162 72	1,131 12	1,631 80	1,528 32
April	835 00	170 53	116 70	1,122 23	2,096 07	....
May	835 00	285 46	2 50	1,122 96	1,243 41	....
June	830 00	188 45	55 51	1,073 96	366 92	....
Totals	10,015 67	2,009 95	1,232 43	13,258 05	8,040 22	4,176 69

SUMMARY.

July, 1884	$4,367 88	February, 1885	$6,038 38
August, 1884	11,077 93	March, 1885	6,455 11
September, 1884	11,200 98	April, 1885	6,293 63
October, 1884	6,078 97	May, 1885	5,552 19
November, 1884	3,754 41	June, 1885	4,698 34
December, 1884	3,470 83		
January, 1885	3,384 93	Total	72,368 58

ANALYTICAL TABLE SHOWING AMOUNT AND COST OF EXCAVATION BY DREDGES DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

		Days.
Time at work		175
Time lost:	Days.	
High water	8	
Ice	32	
Sundays and national holidays	57	
Repairs	30	
Other work	28	
Coal runs	35	
		190
		365
Work:		
Cubic yards excavated		80,034.00
Cubic yards excavated per day		457.34
Cost:		
Salaries for the year		$10,015 67
Salaries per day		27 44
Repairs and supplies for the year		3,242 38
Repairs and supplies per day		8 88
Total		13,258 05
Per day of actual dredging		75.76
Per cubic yard excavated		0.16¼

Statement of vessels passed through the Louisville and Portland Canal, Kentucky, during the fiscal year ending June 30, 1885.

Date.	Number of lockages.	Passenger-boats.		Tow-boats.		Model barges.	
		Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Under-tonnage.
1884.							
July	161	83	20,540	44	4,551	21	6,070
August	144	71	16,627	30	2,820	11	3,023
September	127	62	12,315	33	1,969	6	625
October	171	73	13,748	19	1,309	6	990
November	164	61	12,804	34	2,189	1	226
December	242	59	18,234	64	8,046	23	6,412
1885.							
January	142	43	17,977	42	5,083	19	5,999
February	85	29	16,131	23	4,098	2	500
March	352	69	34,776	74	9,387	19	6,229
April	276	42	20,640	88	11,333	25	8,204
May	591	84	39,914	116	12,678	25	8,149
June	558	66	31,357	105	12,736	43	13,426
Total	3,013*	742	255,063	772	76,199	201	59,853

*Of these lockages, 2,527 were made by new locks, and 486 by the old locks.

Statement of vessels passed through the Louisville and Portland Canal, &c.—Continued.

Date.	Coal-boats.		Square barges.		Small boats.	Rafts.	Government boats.	
	Number.	Measured. capacity.	Number.	Measured capacity.			Number.	Under-tonnage.
1884.								
July	8	3,440	79	16,225	34	1	2	56
August	......	....	93	20,980	29	......	7	392
September	......	....	53	6,711	24	......	2	112
October	......	....	47	5,612	54	......	22	1,068
November	1	430	60	7,904	23	......	3	106
December	100	43,000	281	62,914	42	......	2	....
1885.								
January	67	28,810	104	25,328	6	......	14	570
February	52	22,360	54	12,596	2	......	14	700
March	133	57,190	172	89,602	16	......	......	....
April	181	77,830	283	62,259	10	.....	10	340
May	167	71,810	345	74,070	10	3	29	4,581
June	250	102,130	355	75,704	15	1	11	370
Total	959	407,000	1,926	409,905	265	5	116	9,211

SUMMARY.

Date.	Number.	Under-tonnage.
1884.		
July	272	50,882
August	241	43,842
September	180	21,732
October	221	23,583
November	193	23,659
December	571	138,606
1885.		
January	295	83,677
February	176	56,535
March	483	147,184
April	639	180,606
May	779	211,202
June	846	235,723
Total	4,886	1,217,231

Detailed statement of vessels passed over the Falls of the Ohio River, with number, under-tonnage, and amount of coal and iron ore carried, during fiscal year ending June 30, 1885.

Month.	Descending vessels.										
	Passenger-boats.		Tow-boats.		Model barges.		Square barges.		Coal.	Total.	
	Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Measured capacity.	Bushels.	Number.	Tonnage.
December	9	4,002	5	288	....	....	3	434	....	17	4,724
January	29	14,055	13	1,612	...	....	63	21,200	1,038,000	105	36,867
February	22	10,545	21	2,573	18	5,945	42	6,830	1,696,000	103	25,893
March	9	4,295	8	1,001	....	....	23	5,076	265,000	40	10,372
April	22	9,783	42	6,121	....	....	86	22,926	274,000	150	38,830
May	5	4,928	....	....	....	....	288	110,081	2,600,000	298	115,009
June	....	.....	..	....	....	....	....	....	....	.....	....
Total	96	47,608	89	11,595	18	5,945	505	166,547	5,873,000	708	231,695

Detailed statement of vessels passed over the falls of the Ohio River, &c.—Continued.

Month.	Ascending vessels.										
	Passenger-boats.		Tow-boats.		Model barges.		Square barges.		Iron ore.	Total.	
	Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Measured capacity.	Tons.	Number.	Tonnage.
December											
January	9	3,361	7	1,308	5	1,530	4	984	1,200	25	7,183
February	3	1,638	3	996						6	2,634
March	3	1,145	4	418						7	1,563
April	5	2,470	33	3,050			19	7,420		57	12,940
May											
June											
Total	20	8,614	47	5,772	5	1,530	23	8,404	1,200	95	24,320

SUMMARY.

Month.	Number.	Tonnage.
December	17	4,724
January	180	44,050
February	109	28,527
March	47	11,985
April	207	51,770
May	243	115,009
June		
Total	803	256,015

Commerce passing the Falls of the Ohio by canal and by river.

Years.	Through canal.		Descending open river.		Ascending open river.		Total.	
	Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Under-tonnage.	Number.	Under-tonnage.
1880–'81	4,196	1,124,838	1,220	377,055	503	140,306	5,919	1,642,199
1881–'82	3,964	904,343	1,793	537,906	750	220,965	6,507	1,663,214
1882–'83	4,954	1,226,455	1,294	398,240	179	61.802	6,427	1,686,497
1883–'84	4,346	1,070,650	1,884	432,575	801	98,757	6,031	1,602,982
1884–'85	4,886	1,217,231	708	231,695	803	256,015	6,397	1,704,941

CUSTOMS RECEIPTS AT THE PORT OF LOUISVILLE.

The amount of duties on imports collected at the port of Louisville during the fiscal year ending June 30, 1885, was $106,045.07. All the goods on which these duties were collected were transported by railroad.

C C 4.

IMPROVEMENT OF THE FALLS OF THE OHIO RIVER AT LOUISVILLE, KENTUCKY.

This work is, in fact, the enlargement of the upper portion of the Louisville and Portland Canal, in accordance with the plans recommended in my annual report for 1883.

Owing to delays caused by the necessity of settling certain legal questions before letting out the work by contract, and the advanced state of the season when these questions were finally settled, work during 1884 was carried on by hired labor, and was limited to excavating a drainage-ditch through the middle of the proposed enlargement of the harbor of Louisville.

In the spring of 1885 it was decided to use the available funds ($280,000) in the excavation of so much of the area to be included in the enlarged canal as lies between the canal-property line and a line drawn 25 feet north of the present north wall of the canal and parallel to the same. This work was divided into two nearly equal parts, and proposals were opened on the 24th of June, 1885, with the following result:

Abstract of proposals for earth and rock excavation in the enlargement of the Louisville and Portland Canal, opened June 24, 1885.

[Upper section, approximate quantities; cubic yards earth excavation, 94,461; solid rock excavation, 46,449; loose rock excavation, 1,500; removal of dry wall, 4,152.]

No.	Bidders.	Earth per cubic yard.	Solid rock per cubic yard.	Loose rock per cubic yard.	Dry wall per cubic yard.	Total.
1	John Molloy	$0 22	$1 10	$0 75	$0 90	$76,737 12
2	Barton & Steele	87½	86	49	90	79,840 81
3	Peters & Scully	88	90	55	75	81,638 28
4	Jacob S. Lowry	35	95	80	80	81,709 50
5	George W. Lewis	23	1 20	85	1 00	82,891 83
6	Patrick E. Roach	24½	1 24	56	60	84,055 90
7	Charles R. Long	25	1 25	50	55	84,710 10
8	C. I. McDonald	88	97	55	1 00	85,927 71
9	Craig & Keigwin	38	1 12½	70	65	91,899 10
10	John Scullin	38	1 19½	65	60	94,867 93
11	Fruin Bambrick Construction Company	40	1 15	65	65	94,874 55
12	Marshall Morris	23	1 50	50	75	95,263 58
13	Clark, Monroe & Co	39	1 25	50	40	97,311 84
14	Stephen P. Myer	30	1 42	1 30	1 10	100,813 08
15	James McArthur	25	1 50	1 50	1 50	101,766 75
16	Norris & Peabody	30	1 50	80	70	102,118 20
17	Edward Ryan	33¾	1 44½	69¼	55¾	102,352 88
18	Dexter Belknap	32	1 45	1 50	1 10	104,395 77
19	Frost & Shaw	29	1 60	90	60	105,553 29
20	Carkin, Stickney & Cram	36	1 46	75	90	106,683 30
21	Beckwith & Quackenbush	35	1 45	1 45	1 00	106,739 40
22	C. P. Selvage	30	1 65	90	70	109,235 55
23	L. P. and J. A. Smith	38	1 50	79	1 10	111,320 80
24	William F. Shanks	35	1 70	90	70	116,281 05
25	Joseph Wolf	37	1 65	75	90	116,453 22
26	Daniel F. Minahan	50	1 62	90	1 75	131,098 88
27	Peter Scully	33	2 05	1 00	2 00	136,196 58
28	Michael Gleason	50	3 00	50	80	190,649 10
29	C. C. Murphy	75	2 50	1 00	1 00	192,620 25
30	Delemater, Stanley & Co	83	3 75	2 30	2 30	218,855 48

Abstract of proposals for earth and rock excavation in the enlargement of the Lo
Portland Canal, &c.—Continued.

[Lower section, approximate quantities: cubic yards earth excavation, 103,356; solid roc
37,402; loose rock excavation, 500; removal of dry wall, 5,413.]

No.	Bidders.	Earth per cubic yard.	Solid rock per cubic yard.	Loose rock per cubic yard.	Dry wall per cubic yard.
5	George W. Lewis	$0 22½	$1 08	$0 70	$0 85
1	John Molloy	24	1 15	80	95
9	Craig & Keigwin	34	95	50	50
12	Marshall Morris	24	1 20	80	80
6	Patrick E Roach	24½	1 24	55	60
7	Charles R. Long	25	1 25	50	55
2	Barton & Steele	37½	86	49	90
4	Jacob S. Lowry	35	95	80	80
3	Peters & Scully	38	90	55	75
23	L. P. and J. A. Smith	28	1 85	50	98
8	C. I. McDonald	38	95	50	90
18	Dexter Belknap	27	1 30	1 50	1 10
13	Clark, Monroe & Co	33	1 25	50	40
19	Frost & Shaw	28	1 40	70	60
11	Fruin Bambrick Construction Company	40	1 15	65	65
17	Edward Ryan	34¾	1 34½	61½	49½
32	Arthur F. McArthur	25	1 50	1 50	1 50
14	Stephen P. Myer	31	1 40	1 30	1 15
25	Joseph Wolf	30	1 50	65	85
20	Carkin, Stickney & Cram	34½	1 38	75	90
31	Charles Peterson	35	1 40	1 40	1 25
24	William F. Shanks	30	1 65	80	70
22	C. P. Selvage	30	1 65	90	70
26	Daniel F. Minahan	38	1 65	90	1 65
27	Peter Scully	35	1 95	1 00	2 00
29	C. C. Murphy	43	1 97	1 49	79
28	Michael Gleason	48	2 35	40	70
30	Delamater, Stanley & Co	26	2 99	1 09	1 09

The contracts for the above work were awarded to the lowest
viz., John Molloy, for upper section, and George W. Lewis, for lo
tion. Both contracts were executed under date of July 1, 1885
The two contracts referred to above were let at figures so lo
large sum was left available for an additional contract. This th
tract was let after the close of the fiscal year.

Accompanying this report is a map showing the work now
plated in the enlargement of the upper part of the Louisville an
land Canal. It will be noted that some modifications in detail ha
made since the report of 1883, the chief one being the inclusio
canal of both of the draw spaces of the railroad bridge. Specia
observations at this locality have shown that in times of high
when boats cannot get under the high spans of the bridge, th
spaces are in slackwater, and boats can readily pass over a w
higher than 13 feet above the bottom of the canal. By includi
northern draw space in the canal we get the benefit of the add
width of canal, and the passage of the bridge is much easier fo
as they can pass through either draw space. The present
through the northern draw space is crooked and difficult, and
stantly obstructed by deposits. The proposed change will rem
of these objections. This work is a very important one, and th
ests of commerce require that it be pushed as rapidly as possi
would estimate that $500,000 could be profitably expended in thi
during the next fiscal year.

The report of Mr. P. J. Schopp, assistant engineer in charge, i
to annexed.

R

Money statement.

Amount appropriated by act approved July 5, 1884		$300,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$15,650 44	
July 1, 1885, outstanding liabilities	168 15	
		15,818 59
July 1, 1885, amount available		284,181 41
Amount (estimated) required for completion of existing project		1,035,363 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		500,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1868 and 1867.

REPORT OF P. J. SCHOPP, ASSISTANT ENGINEER.

LOUISVILLE, KY., *July* 1, 1885.

SIR: I have the honor to submit herewith my annual report for the fiscal year ending June 30, 1885, upon improving falls of Ohio River at Louisville, Ky.

Work on this section of the falls improvement was not commenced until October 10, 1884; it was continued until December 10, 1884, when a rise in the river stopped it; 817 cubic yards of earth excavation and 2,363 yards of rock excavation were made during that time.

Several hundred yards of rock were removed from inside the Government property line, but by far the greater portion came from a draining ditch reaching from near the canal to the river-bed. The ditch was cut in anticipation of a large amount of rock excavation, in order to drain the working-pit. It is finished for 1,400 feet, and partly finished for its entire length of 1,900 feet. It is from 6 to 8 feet wide and from 1 to 6 feet deep.

A minute survey of the proposed improvement was made preparatory to giving out the work by contract.

Very respectfully, your obedient servant,

PHIL. J. SCHOOP,
Assistant Engineer.

Col. W. E. MERRILL,
Corps of Engineers.

C C 5.

IMPROVEMENT OF MONONGAHELA RIVER, WEST VIRGINIA AND PENNSYLVANIA.

The project, of which Lock and Dam No. 8 is the only unfinished portion, contemplates the extension of the Monongahela slackwater which now terminates at Dunkard Creek, Pennsylvania, to Morgantown, W. Va., a distance of 14 miles. To overcome the lift of 21½ feet, two locks and dams are required, one of which, No. 9, is finished and in operation, while No. 8 is yet to be completed.

The work of building Lock No. 8 was resumed on the 28th of July, 1884, and was pushed with energy until December 11 when operations were stopped by cold weather and high water. During this period 5,460 cubic yards of masonry were laid, and the entire work with the exception of the lower wing-wall was built to a height of from 2 to 4 feet above the pool of Dam No. 7.

The original estimate of the cost of building this lock and dam, as given in my annual report for 1876 (Report of the Chief of Engineers for 1876, Part II, page 56), was $189,000.

I was mistaken in stating in my last annual report that the original estimate for this work was $164,000. The error originated in my annual report for 1881, and was due to taking the amount reported in 1880 as still needed to be the original estimate, whereas it was really the original estimate less the first appropriation of $25,000. The error was chiefly due to the fact that the report in question was written while I was absent from my office on account of sickness.

Since 1880 there has been appropriated for improving the Monongahela River the sum of $120,000, of which $4,906.72 has been expended for the running expenses and repairs of Lock and Dam No. 9, and $111,368.94 on Lock and Dam No. 8; leaving a balance of $3,724.34 now available. To complete Lock and Dam No. 8 will require an additional expenditure of $125,000, as is shown in detail in the accompanying report of the resident engineer, or $121,276 in addition to the balance now on hand. The total cost of the work will therefore be $236,369 instead of $189,000, an increase of $47,369 or 25 per cent.

This excess of cost over the original estimate is accounted for as follows: The original estimate was made for a location at Laurel Run, where it was reported by the assistant engineer who made the examination that rock could be found at a depth of 5 feet, and estimates were based on this depth. Subsequent examinations by another assistant showed that this report was in error, and that what had been supposed to be solid rock bottom was merely imbedded bowlders. After careful search the site of the work was changed to the mouth of Dunkard Creek, where rock was found at a depth of 10 feet. No better site could be found in the region where the lock had to be placed; but the extra depth coming in the wide foundation courses largely increased the amount of masonry in the lock, and seriously added to the cost of the dam and abutment.

Revised estimates might have been made at an earlier date, but hydraulic work is subject to so many casualties that it did not seem advisable to prepare them until the lower courses of the lock were completed. This condition was not reached until last December.

Another cause of increase in cost is the great length of time consumed in the work on account of the insufficiency of the appropriations to secure economical results and the total loss of two working seasons by the lack of any appropriation. It is only necessary to add that the first appropriation was made in 1880, and that in all probability at least two more working seasons will be required to complete the lock and dam. The whole structure could have been completed in two seasons had the funds been available from the beginning. When work drags over many seasons the expenses of general administration are much increased, floods damage unfinished parts, coffer-dams and plant must be repaired or renewed from time to time, and innumerable petty expenses add greatly to the ultimate expenditure.

For further details reference is made to the annexed report of the resident engineer, Mr. L. M. Petitdidier.

COMMERCIAL STATISTICS.

As stated in my last annual report the record of the commerce passing the Government lock at Hoard's Rocks No. 9, owing to the isolated position of this lock, is of little value in estimating the amount of traffic which will result upon the completion of Lock No. 8 and the final opening of a continuous slackwater navigation from Pittsburgh to Morgantown. The following table, compiled from the monthly reports of the lock-keeper at No. 9, shows the actual commerce passing this point.

Commerce passing Lock No. 9, Monongahela River, during the fiscal year ending June 30, 1885.

Date.	Lockages.	Going up.				Going down.							
		Steamboats.	Barges and flats.	Miscellaneous.	Merchandise.	Steamboats.	Barges and flats.	Boat bottoms.	Rafts.	Miscellaneous.	Merchandise.	Lumber.	Timber.
1884.					*Tons.*						*T'ns.*	*Ft. B.M.*	*Cu. ft.*
July	11	......	2	3	65	1	....	....	7	....	2		10,000
August	3	......	1	....	44	....	2	....	......	1	.....	....	....
September	.....	......	......	....	59	....	....	....	......	....	.....	....	....
October	.....	......	......	....	5	....	....	....	......	....	.....	....	....
November	.....	......	......	....	24	....	....	....	......	....	.....	....	....
December	17	5	4	1	73	5	....	....	2	2	1	46,000	....
1885.													
January	21	9	......	....	25	9	....	....	3	....	.....	....	12,600
February	.....	......	......	....	......	....	....	....	......	....	.....	....	....
March	6	2	6	....	66	2	2	....	......	....	3	....	....
April	121	24	......	2	168	25	3	2	88	2	1	622,000	214,900
May	76	5	11	36	129½	5	7	....	......	31	.....	4,000	....
June	25	......	6	6	102	....	4	....	8	5	1	3,500	10,700
Totals	280	45	30	48	760½	47	18	2	108	41	8	675,500	248,200

The following statistics are taken from the last annual report of the Monongahela Navigation Company, and show the commercial movement on the lower, or northern, end of the river:

SHIPMENTS ON THE MONONGAHELA SLACKWATER IN 1884.

Brick	number..	652,126
Cattle and horses	do....	289
Classified freight	pounds..	27,779,991
Coal, coke, and slack	bushels..	81,706,852
Fire-clay	tons..	2,140
Hogs	number..	3,381
Iron ore	tons..	20,840
Iron in pigs	do....	17
Lumber	feet..	7,142,447
Oil	barrels..	52
Posts	number..	255
Posts, pit	do....	219,200
Railroad ties	do....	16,750
Sand	bushels..	679,000
Sheep	number..	5,677
Steel rails	tons..	23,844
Stone	perches..	32,067
Timber	feet..	2,091,740
Whisky	barrels..	6,770
Passengers	number..	26,871

ESTIMATE FOR 1886-'87.

In order to secure the best and most economical results, it is essential that the entire sum required to complete the work should be appropriated at once. I therefore submit an estimate for $121,276.

Money statement.

July 1, 1884, amount available	$2,159 26
Amount appropriated by act approved July 5, 1884	45,000 00
	47,159 26
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	43,434 92
July 1, 1885, amount available	3,724 34

Amount (estimated) required for completion of existing project	$121,276 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	121,276 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF L. M. PETITDIDIER, ASSISTANT ENGINEER.

CINCINNATI, OHIO, *May* 20, 1885.

COLONEL: I have the honor to submit the following report for the season of 1884 on the work of construction of Lock No. 8 on the Monongahela River, 88¼ miles above Pittsburgh.

After the passage of the river and harbor act of 1884 you instructed me to proceed at once with the construction of this lock.

In order to explain the condition of affairs before commencing work, it is well to state what had been done during the preceding working season, which was in the fall of 1882. A coffer-dam 122 feet by 115 feet to inclose the upper end of the lock had been built 5 feet above low water, and 810 cubic yards of masonry, forming portions of the head wall and of the spurs of the upper wing-wall and upper buttresses, had been laid to a height of 3 feet above low water.

In 1882 and 1883 the Monongahela Navigation Company built Lock and Dam No. 7, 4 miles below Lock No. 8, and raised the low-water level at the latter point 5 feet, submerging the coffer-dam built in 1882 and covering the masonry to the depth of 2 feet.

Operations for the season of 1884 were commenced on July 28, the work being performed by hired labor. The coffer-dam was repaired and raised 3 feet and extended down-stream sufficiently to inclose the remainder of the lock. The excavation of earth and hard gravel was commenced on August 6 and continued until the latter part of November, the amount of material excavated being 5,610 cubic yards. Masonry work was begun on the upper land buttress on August 27 and was prosecuted actively until December 11, the amount of masonry laid during this period, including concrete for leveling foundations, being 5,460 cubic yards. This includes the building of the entire lock, with the exception of the lower wing-wall, to a height of from 2 to 4 feet above the level of Pool No. 7.

It is estimated that 60 per cent. of the masonry of the lock has been laid, but this quantity represents at least 75 per cent. of the work, as the most tedious and difficult part is done and the lock can now be completed without the necessity of a coffer-dam, and the work is no longer subject to serious interruption by freshets.

In the masonry, American Portland cement has been used exclusively for all cut-stone work, as it is deemed much preferable on account of its great strength and adhesive qualities.

With the exception of a delay of ten days, caused by the inability of boats to transport cement during an unusual low stage of the river, the season's work was carried on under most favorable circumstances. The weather was all that could be desired, and the coffer-dam was submerged for the first time in the month of December.

A careful estimate of the cost of completing Lock and Dam No. 8, is as follows:

Lock, including machinery	$42,275
Dam	50,054
Abutment of dam	10,000
Retaining-wall and crib-works	17,831
Lock-keeper's dwelling	2,000
Contingencies	2,840
Total	125,000

I transmit herewith four photographs of the work and vicinity.

Very respectfully, your obedient servant,

L. M. PETITDIDIER,
Assistant Engineer.

Col. WILLIAM E. MERRILL,
United States Engineers.

C C 6.

OPERATING AND CARE OF LOCK AND DAM NUMBER 9, MONONGAHELA RIVER.

The expenses of operating this work are limited to the salary of one lock-keeper, and the repairs necessitated from time to time by floods and accidents.

During the autumn of 1884 the damage mentioned in last year's report was thoroughly repaired, and a heavy crib filled with riprap and concrete was attached to the lower slope of the dam in order to destroy the reaction which was the original cause of the breach.

The lock and dam passed through the winter of 1884–'85 with no other injury than a slight abrasion of the concrete coping. For further details reference is made to the annexed report of Mr. L. M. Petitdidier, the resident engineer in charge of Government improvements on the Monongahela.

Statement of expenses incurred during the fiscal year 1884–'85.

Date.	General administration.			Repair of dam.				Grand total.
	Salary of lock-keeper.	Contingent expenses.	Total.	Labor.	Tools and appliances.	Materials.	Total.	
1884.								
July	$50 00	....	$50 00	$12 15	$6 18	....	$18 33	$68 33
August	50 00	65 12	115 12	801 39	30 30	$1,693 25	2,524 94	2,640 06
September	50 00	....	50 00	1,251 93	8 50	3,472 11	4,732 54	4,782 54
October	50 00	....	50 00	1,035 00	....	683 93	1,718 93	1,768 93
November	50 00	96	50 96	219 25	....	201 75	421 00	471 96
December	50 00	24	50 24	....	....	....	....	50 24
1885.								
January	50 00	....	50 00	....	....	5 97	5 97	55 97
February	50 00	....	50 00	....	....	....	....	50 00
March	50 00	3 75	53 75	....	....	....	....	53 75
April	50 00	....	50 00	....	....	....	....	50 00
May	50 00	....	50 00	....	....	....	....	50 00
June	50 00	....	50 00	....	....	....	....	50 00
Total	600 00	70 07	670 07	3,319 72	44 98	6,057 01	9,421 71	10,091 78

ESTIMATE FOR 1885–'86.

Salary of lock-keeper	$600
Contingencies	400
	1,000

ESTIMATE FOR 1886–'87.

Salary of lock-keeper	600
Contingencies	400
	1,000

REPORT OF L. M. PETITDIDIER, ASSISTANT ENGINEER.

CINCINNATI, OHIO, *May* 25, 1885.

SIR: I have the honor to submit the following report, for the season of 1884, on the work of repairs at Lock and Dam No. 9, on the Monongahela River, 93¼ miles above Pittsburgh, and in the State of West Virginia:

A part of the crest of this dam and a few stones of the second and third courses and of the down-stream facing were carried away by flood and drift in December, 1880. In January, 1881, the remainder of the coping was removed, thus lowering the whole dam 2½ feet; but attempts to repair the break were defeated by a constant succession of freshets. Meanwhile the damage gradually increased, and when I arrived at the work, in August last, I found a break on the end adjoining the lock 110 feet long and 5¼ feet deep. All the courses of stone forming the down-stream slope had also been carried away for the whole length of the gap.

After a careful examination of these damages you decided to build a protection-crib below the gap, and to restore the dam to its original status, except the coping. This crib was to serve two purposes: first, to prevent backlash below this part of the dam, and, second, to prevent undermining.

Operations were commenced early in August, and a temporary crib coffer-dam was erected above the gap.

The two top courses of masonry were first replaced, commencing August 27. The protection-crib below the dam was begun early in September and finished by October 11. The slope stones were then replaced and laid in Portland-cement mortar. They were also fastened with iron clamps along their beds.

The crib is filled with concrete along its vertical sides, and with riprap for inner filling. Its walls are solid, and built of oak above low-water level, the top sheathing being of the best white-oak, 12 inches thick. It measures 106 feet in length, and is 7 feet 6 inches above low water at its outer end, the slope of the top being about 1 foot.

Other minor repairs at this place consisted in rounding off the top of the whole dam with a layer of concrete whose greatest thickness is 27 inches, and in dressing off the whole lower slope of the dam so as to offer less resistance to large logs which frequently pass over in high water, and then, borne back by a surface current, strike against the dam with great violence.

About 400 cubic yards of gravel were placed behind the upper land-wall buttress to fill up a hole cut out by the river during a high flood. The top surface was then paved.

Immediately below the lock the bank behind the retaining-wall was covered with 200 cubic yards of riprap as a protection against wash in time of floods.

I transmit herewith two photographs, taken before and after the repairs of the dam, respectively.

Very respectfully, your obedient servant,

L. M. PETITDIDIER,
Assistant Engineer.

Col. W. E. MERRILL,
Corps of Engineers.

C C 7.

IMPROVEMENT OF ALLEGHENY RIVER, PENNSYLVANIA.

The appropriation of $35,000 made by the river and harbor act of July 5, 1884, was expended in continuing the removal of the huge rocks that obstruct the shores and bed of this river and in repairing the dam at Nicholson's Island. For details reference is made to the annexed report of Mr. I. V. Hoag, jr., the resident engineer, which likewise contains such commercial statistics as could be obtained.

I would recommend that the work of removing rocks be continued up-stream as far as Olean, and I would also recommend that an inclined plane be built at the Corydon Dam, so as to lessen the danger to life and injury to property in passing this dam.

No definite estimate can be made of the cost of the work herein outlined, but it is estimated that $100,000 could be advantageously expended on the Allegheny River during the ensuing fiscal year.

Money statement.

July 1, 1884, amount available	$816 69
Amount appropriated by act approved July 5, 1884	35,000 00
	35,816 69
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	35,182 40
July 1, 1885, amount available	634 29

Amount that can be profitably expended in fiscal year ending June 30, 1887	$100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF I. V. HOAG, JR., ASSISTANT ENGINEER.

PITTSBURGH, PA., *February* 6, 1885.

COLONEL: I have the honor to submit the following report of the operations for the improvement of the Allegheny River during the season of 1884:

No contract work of any kind was done. Your project, approved by the Chief of Engineers, contemplated only the necessary repairs to the dam at Nicholson Island and the removal of obstructions. For the latter work nine separate parties were engaged in the month of July. These parties consisted each of one foreman, twelve laborers, and five teamsters and teams. They were supplied with roughly-made drag-sleds and all necessary tools and implements for reducing rock and other obstructions to a portable size. Dynamite was also freely used.

The object of this work was to effectually clean up the bed of the river, and by so doing materially increase the navigable depth and also lessen the dangers to floating craft at the higher stages by clearing the more prominent shore-bars. Where the water was too deep to do the work by hand a crane-boat and deck-barges were employed. All material removed was deposited on the bank slopes at a height sufficient to preclude the probability of its being again carried into the stream by ice.

The working parties described were distributed to various points on the river between Pittsburgh and Hickory, a distance of 160 miles.

The following is a statement of the work done on the various sections of the river:

From—	Miles from mouth of river.	To—	Miles from mouth of river.	Rocks removed (cubic yards).	Snags removed.	Gravel removed (cubic yards).	Wrecks removed.	Remarks.
Hickory	160	Scrubgrass	119½	8,279	236	1,555	....	Party No. 1, J. H. Jones, foreman.
East Sandy	121	Foster	119	9,649	18	......	....	Party No. 2, J. R. Hutton, foreman.
Parker	84½	Brady's Bend	70½	9,897	18	......	....	Party No. 3, S. H. Richardson, foreman.
Dickson's Falls	61½	Mahoning	57½	7,371	31	......	....	Party No. 4, D. G. Foy, foreman.
Templeton	56	Kittanning	46½	6,623	14	......	....	Party No. 5, H. Crawford, foreman.
Kittanning	46½	Clinton	36	7,419	151	......	....	Party No. 6, T. J. Hudson, foreman.
White Rock	35	Freeport	30	7,772	45	......	....	Party No. 7, J. P. Hudson, foreman.
Schenley	31	....	......	*6,200	....	2,000	....	Party No. 8, E. E. Shaw, foreman.
Freeport	30	Garrison Ripple	8	7,439	335	......	1	Party No. 9, J. M. Hudson, foreman.
Totals	......	....	......	70,649	848	3,555	1	

* This rock consisted of the old aqueduct piers, which were removed by the crane-boat.

The repairs needed to the dam closing the left chute at Nicholson Island, 37 miles from Pittsburgh, were found to be quite extensive. The damage to this work was first occasioned by the superstructure of the Emlenton Bridge, 53 miles above this point, which, having been carried from its piers during the spring floods of 1883, lodged on this dam, where it finally went to pieces. The iron work of the bridge made a number of breaches in the dam, which were afterward greatly increased by water and ice.

This dam has been placed in a state of complete repair at the following cost, viz:

COST OF REPAIRS OF DAM AT NICHOLSON ISLAND IN 1884.

80,596 feet (B. M.) timber	$1,509 12
2,919½ cubic yards of riprap stone	2,175 57
121 cords brush	78 65
8,161 pounds bolts and spikes	179 36
Services, charged on pay-rolls	2,376 22
	6,318 92

The difficulty occasioned by low bridges does much to prevent a more universal appreciation of what has been accomplished on this river, and prevents a return to steam navigation, which was in a flourishing condition up to the year 1867; but, owing to the erection of numerous cheap low bridges, navigation is now almost wholly carried on by means of boats propelled by horses.

The Allegheny Valley abounds everywhere with evidences of latent wealth, yet its interests have been so neglected, and so little has been done toward the improvement of the river, that all its commerce has hitherto been confined to periods of high water. Under these circumstances no regular or systematic collection of the statistics of its struggling trade has ever been attempted, and no approximation could be relied upon, except in regard to the extent of the timber trade, hereinafter referred to. While the general commerce is very important, and evidently of considerable amount, yet, for the reasons given, it is so desultory in character, that no satisfactory exhibit could be given without a thorough personal canvass, which would require more time and expense than can be spared for the purpose.

A summary of the disbursements for the season's work is as follows, viz:

For materials and implements	$5,468 11
For labor	29,165 51
For incidental expenses	549 76
Total	35,183 38

There is much work in the nature of the removal of obstructions yet to be done, but the improvement to navigation already accomplished is apparent to the most casual observer, and the natural features of the Allegheny River, together with its boundless resources of iron ore, coal, sand, and limestone, fire-clay, timber, oil, and natural gas will now compare favorably with those of any other stream of which I have knowledge. There is, perhaps, no other river in this country so susceptible of radical improvement as the Allegheny, and if this work is not undertaken by the General Government, I am firmly impressed with the belief that private enterprise will soon be attracted by the advantages of such an investment. To foster this spirit of development it is manifestly the interest of the Government to carefully consider the recommendations embodied in your previous reports relative to the construction of the first lock and dam at Herr's Island. (See Reports of Chief of Engineers for 1882 and 1883.)

A special examination and survey of the proposed location of this dam was made during the month of October, and the maps of the same have been placed on file in your office.

Gas, as a natural concomitant to the great reservoirs of petroleum or rock oil, has been at all times encountered in great volumes during the usual explorations for oil. It has been for years utilized in the oil country for illuminating and all heating purposes.

Comparatively recent discoveries have developed in many places in the Allegheny Valley the presence of strong veins of this natural gas, and at very remote distances from any oil-bearing territory. Several large corporations have laid cast-iron pipes of from 8 inches to 12 inches diameter in the bed of the river, and crossing it at several points, to convey this gas to the various industrial establishments of Pittsburgh and vicinity, where it is used as fuel. These lines of pipe are sometimes laid across ripples, notably at the head of Herr's Island, known as Garrison Ripples, where five separate lines cross the river within a distance of 1,000 feet.

This pipe is usually placed on the bed of the stream without protection, except in shallow water, where it is placed at about the level of the bed of the river, and is held in place by iron pickets having their tops fashioned into half circles which clasp the pipe when driven down.

Some fears have been expressed by navigators of injury to their boats by these pickets. I know of but one instance where any actual injury has resulted. An investigation of that case showed that the damage was done while the pipe was being placed, and before the pickets were entirely driven down. Since these pipes are frequently laid on ripples, where the current is naturally strong, it appears probable that the water may cause a scour under them sufficient to permit the pipe to settle. If this should happen, the iron picket left standing would doubtless prove a dangerous obstruction.

The companies operating these lines are, I believe, all organized under the laws of the State of Pennsylvania, and a list of them may be found with the secretary of that Commonwealth. I am not familiar with the conditions of their franchises under the State law, but I would suggest that they be officially notified of their liability in this matter under United States law.

The water has been too high since these pipes were laid to fully determine whether they constitute a nuisance, and, pending such an examination, no further recommendation seems necessary.

Some early and decisive steps should be taken to restrict the work of sand-digging in the river. The manner in which this is now being done is absurd and an outrage to public rights. They anchor their boats wherever they please and proceed with their excavation, screening the sand into flat-boats, and throwing the gravel and bowlders back into the river, where it is left piled up in huge mounds, which constitute a most serious obstruction to all commerce.

I am aware that the remedy in this case lies in an action at law, and I would therefore recommend that the district attorney at this point be requested to extend to the engineer in charge his aid in abating this evil.

The statistics of but one branch of trade show the enormous aggregate of 200,000,000 feet B. M. of timber annually transported on the river. The harbor for the greater part of this product is above Herr's Island, and within a few miles of Pittsburgh, where it is held for market, and the loss on this timber, principally from sap-rot, which is solely due to the meager facilities for transportation occasioned by uncertain water, is modestly put by Messrs. Stoner and McClure, of Pittsburg, prominent timber millmen, who annually cut 12,000,000 feet of this timber, at 10 per cent. of the whole amount so held. Besides this important item, exhaustless quantities of valuable building stone can be found on this river within a very moderate distance of Pittsburgh. At present the first cost of all building stone used at Pittsburgh is nearly doubled by the cost of railroad transportation, and it is estimated that at least 10 per cent. of the cost of all stone-work in the vicinity of Pittsburgh might be saved simply by the reduction in freights which would result from this one improvement.

Very respectfully, your obedient servant,

I. V. HOAG, JR.,
Assistant Engineer.

Col. WILLIAM E. MERRILL,
United States Engineers.

C C 8.

ICE-HARBOR AT MOUTH OF MUSKINGUM RIVER, OHIO.

Work of construction was resumed on July 14 and continued until the season closed at the end of November. When operations were begun the most difficult and dangerous part of our work was before us—the prolongation of the lock through the State dam. When it closed this hazardous enterprise had been successfully accomplished, and everything that came within the area of the coffer-dams was finished, thus assuring the early completion of the ice-harbor. Although not much more than half the structure is built, the work may be said to be two-thirds completed, as the portion yet unfinished is very much less difficult than the part already built. The present condition of the work is shown on the accompanying drawing.

To complete the project will require an expenditure of $96,000, as shown in detail in the accompanying report of Mr. William Weston, the resident engineer, to which reference is made.

There have been expended on this work $199,145.37, and as $96,000 more is required, of which $836.63 is on hand, there is yet $95,163.37 to be appropriated. The total cost of the work, will therefore be, in round numbers, $296,000.

The estimated cost of this work, as given in my annual report for 1880, is $216,400. The increased cost over the estimate is, therefore, $79,600, or 37 per cent. This increase is partly due to the fact that the work proved unexpectedly difficult, and partly to the small appropriations and consequent slowness of construction, which made it frequently necessary to build, destroy, and rebuild temporary works of protection that would have been unnecessary had the work progressed more rapidly. At the close of each season it was necessary to leave the State dam and the adjacent coffer-dams in such a condition as to be safe against floods from the Muskingum. Any failure in this respect would have caused the destruction of the dam, and possibly of some of the neighboring mills, besides wholly stopping navigation.

The cost of keeping down the water in the coffer-dam has been unusually heavy, as under the clay we found a bottom of quicksand, and the constant head of 20 feet caused an inflow that required the constant running of two 10-inch centrifugal pumps.

There were also much annoyance and expense in keeping up a water-tight connection with the State dam, and after the floods of each winter heavy expenditures were required on all temporary structures, and especially on the coffer-dam below the State dam, which was exposed to the heavy eddies and reactions due to the fall of 12 feet.

If the lock could have been built as locks usually are built—before there was any dam—the work could have been completed within the estimate.

The following contracts for materials were made during the year:

By advertisement, dated August 2, 1884, proposals were invited for furnishing timber and plank for use in constructing lock at the mouth of the Muskingum River, Ohio.

The following bids were received and opened August 11, 1884:

Proposals for furnishing timber and plank.

No.	Bidders.	86,150 feet B. M. timber and plank.	
		Price per M.	Cost.
1	Marietta Chair Company*	$16 00	$1,378 40
2	Dawes, Irish & Co	17 85	1,537 78
3	D. R. Dunn	17 90	1,542 08
4	C. A. Miller	18 00	1,550 70
5	N. W. Tucker	18 50	1,593 77
6	Alcock & Hayes	18 75	1,615 31
7	Adam Feick	20 00	1,723 00
8	F. McGirr	21 00	1,809 15
9	Parkersburg Mill Company	22 50	1,938 37

*Accepted.

Contract was awarded to the Marietta Chair Company, and executed under date of August 21, 1884.

By advertisement dated August 2, 1884, proposals were invited for furnishing round piles for use in constructing lock at the mouth of the Muskingum River, Ohio.

The following bids were received, and opened on August 11, 1884:

Proposals for furnishing round piles.

No.	Bidders.	10,400 linear feet of round piles.	
		Price.	Cost.
1	Dawes, Irish & Co.*	$0 12	$1,248
2	N. W. Tucker	12	1,248
3	Adam Feick	13	1,352
4	Alcock & Hayes	14	1,456
5	Hammett, Norris & Co	14½	1,508

*Accepted.

Contract was awarded to Dawes, Irish & Co., and executed under date of August 22, 1884.

The annexed report of the resident engineer gives the year's operations in detail.

ESTIMATE.

It is essential to the vigorous and economical prosecution of this work that the entire sum required for completion should be appropriated in one sum. I therefore submit an estimate of $95,163.37 as the amount that should be appropriated in the next river and harbor act.

Money statement.

July 1, 1884, amount available		$5,522 90
Amount appropriated by act approved July 5, 1884		50,000 00
		55,522 90
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$54,557 73	
July 1, 1885, outstanding liabilities	128 54	
		54,686 27
July 1, 1885, amount available		836 63
Amount (estimated) required for completion of existing project		95,163 37
Amount that can be profitably expended in fiscal year ending June 30, 1887		95,163 37
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. WILLIAM WESTON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Cincinnati, March 18, 1885.

COLONEL: I have the honor to submit the following report of operations on the ice-harbor at the mouth of the Muskingum River, Ohio, for the past working season.

PROGRESS AND CONDITION OF THE WORK.

Active operations were begun July 14, 1884, although advantage was taken of the presence of the Ohio River dredge-boats at Marietta in June to replace material washed out of the coffer-dam during the winter. The amount of gravel dredged and deposited for this purpose, was 3,670 cubic yards. This left the coffer in good condition for immediate use.

The work laid out for the season was that of building the middle section of the lock chamber, or that part which intersects the State dam. Previous work had only brought the new structure down to the upper face of the dam. It was now proposed to carry it through the dam, and make secure connections on one side with the dam itself, and on the other with the bank of the new excavation.

When once the main dam was cut, the coffer-dam alone would be left to maintain the water in the pool. As there was a head of 12 feet of water against the dam, the work would be liable to serious damage should the Muskingum River rise above its ordinary summer stage, and overflow the coffer.

As it was impracticable to avoid this risk, and as it must be carried until the lock-walls were built up to the level of the coffer, or until the season's work was nearly done, the situation demanded that the work should be pushed along as fast as possible. A night gang was organized, and operations were kept under way day and night till the end of September. At this time the excavation and pile driving were finished, and except pumping, night work was discontinued, it being impracticable to lay masonry by any artificial light.

By reason of continued low water, the season proved a favorable one, and as labor was abundant, and no delays arose, the proposed season's work was practically closed and everything made safe by the end of November, and before any considerable rise had occurred in the river.

The lock-walls and the concrete foundation were extended to a point 75 feet below the crest of the dam. A bulkhead wall was built between the land lock-wall and the bank, connection made between the outer lock-wall and the State dam, and a section of a guard-crib built on the river side of the lock-wall below the dam.

In addition to this, 300 cubic yards of masonry, laid in 1881, at the head of the land lock-wall, were taken down and reconstructed at a cost of $1,400. This extra work was made necessary by a general opening of joints in the wall, chargeable entirely, as far as I could determine, to bad cement. The wall was well built with mortar mixed in the proportion of one volume of Buffalo common cement to two of

river sand. In places the cement carried only one and one-half times its volum
sand. Tests of mortar mixed in the proportion of one of this cement to two of
by measure gave in general a higher tensile strength at the end of one week
similar samples of other common cement tested, but briquettes of neat cement
ally checked or cracked and fell to pieces when immersed in water. The cement
used on the strength of tests made with mortar mixed in the sample as it was b
mixed and used on the wall. The results, however, proved bad. After stan
over winter the joints began to check and the wall to break up in a serious man
Check-levels were run, but showed no settlement in the foundation of the walls.
trouble seems due to a slaking of lime in the cement or to some similar action, w
has caused an increase of bulk in the mortar.

The lower portion of walls laid with this cement are yet in fair condition, altho
there are occasional checks in joints, and when under water pressure there is s
leakage. The head-piers will have to be reset in part or throughout.

Except the coping for outside wall culvert valves and maneuvering machinery,
upper half of the lock is now completed.

The annexed sketch shows the present condition of the work.

DETAILS OF WORK DONE IN 1884.

Amount of excavation	cubic yards..	11,
Foundation-piles driven	number..	
Other piles, about	do	
Concrete laid	cubic yards..	1,
Masonry laid	do	3,
Masonry taken down and reset	do	
Stone cut	square feet of face..	13,
Special stones cut		

The total amount of concrete laid, as measured in place, was 1,760 cubic yards.
this 2,723 barrels of common cement were used. Assuming each barrel of cemen
equal 3¼ cubic feet, the following figures show the gross amount of material used
concrete: Cement, 336 cubic yards; sand, 505; fine gravel, 575; broken stone, 1,4
total, 2,871 cubic yards of raw material for 1,760 cubic yards of concrete; or, 163 p
of the ingredients to 100 parts of the manufactured article. This mixture is, by me
ure, approximately, 12 parts cement, 18 parts sand, 20 parts fine gravel, and 50 p
broken stone.

In preparing 1,310 cubic yards of stone broken to pass through a 2-inch ring,
contractor for this stone stated that he used up 1,854 cubic yards of riprap, whic
at the rate of 1.41 yards of riprap to produce 1 yard of macadam.

The total masonry laid during the season was 3,399 cubic yards, for which 2,
barrels of common cement were used. Cement used per cubic yard of masonry w
therefore, 0.61 barrels. Mortar mixed one of cement to two of sand.

Mortar mixed in the usual proportions, when one week old, gave 25 per cent. m
tensile strength with hill sand than with river sand.

Material furnished by contract or otherwise.

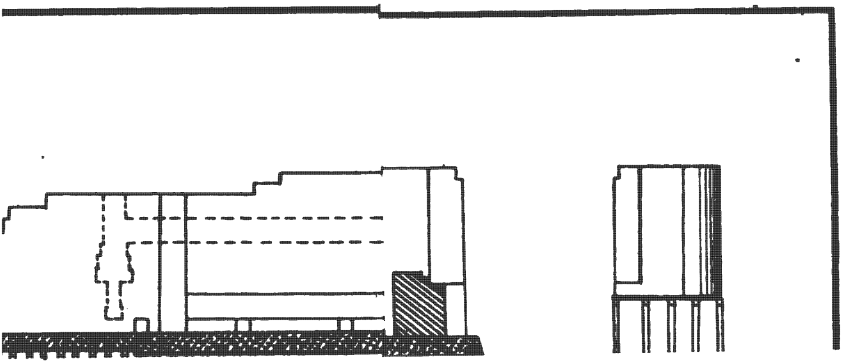
Material.	Unit of quantity.	Quantity.	Price uni
Dimension stone for coping	Cubic yards	13⅜	$3
Riprap	do	181	
Broken stone	do	1,310	1
River sand	do	565	
Hill sand	do	448	1
River gravel (unwashed)	do	685	
White-oak piles, 12 to 20 feet long	Linear feet	14,878	
White-oak timber and plank	Feet B. M	90,914	*16
Cement, delivered	Barrels	4,825	1 25-2
Wrought-iron bolts and straps	Pounds	17,169	
Cast-iron washers	do	7,040	
Coal, Pittsburgh, "steamboat"	Bushels	13,685	
Coal, Pittsburgh, nut	do	8,549	

* Per M.

ESTIMATE TO COMPLETE THE WORK.

The cost of completing the work is estimated as follows:

Coffer-dam and pumping	$10,
Excavation	2,
Foundation piles and flooring	13,



Concrete	$8,000
Stone-cutting and masonry	29,500
Lock-gates and fixtures	6,000
Valves, turbine, and machinery	10,000
Crib-work, bank-protection, and dredging	7,000
Contingencies and engineering, 12 per cent	10,000
Total	96,000

Very respectfully, your obedient servant,

WILLIAM WESTON,
Assistant Engineer.

Col. WILLIAM E. MERRILL,
Corps of Engineers.

C C 9.

HARBOR OF REFUGE NEAR CINCINNATI, OHIO.

The river and harbor act, approved July 5, 1884, appropriated $17,000 or "improving harbor of refuge near Cincinnati, completing improve- ent." This amount, added to the sum of $15,937 on hand at the close f the last fiscal year, made a total of $32,937 for this work. With the pproval of the Chief of Engineers, it was decided to expend this money building a third dike in the Ohio River, at Four Mile Bar, 10 miles bove Cincinnati.

Proposals were invited for this work by advertisement, dated August 7, 1884. The following bids were received and opened September 30, 884:

Proposals for dike at Four Mile Bar.

No.	Bidders.	Materials required.						Total.
		Price per M feet of oak (365,375, feet B, M.).	Price per M feet of hemlock (349,000 feet, B, M.).	Price per M feet of pine (99,982 feet B. M.).	Price per cubic yard of stone (21,175 cubic yards.).	Price per pound of drift-bolts and spikes (76,600 pounds).	Price per cord of brush (575 cords).	
9	*Ware & Pyle	$18 45	$16 45	$17 45	$0, 83	$0 04½	$2 25	$36, 542 89
4	J. J. Shipman	19 00	19 00	19 00	94	0 04½	2 50	40, 216 78
35	William H. Wheeler	26 50	25 00	28 00	94	03	1 60	44, 329 42
22	P. H. Kelley	28 00	22 00	28 00	1 10	04	1 50	47, 926 97
5	John B. Holbrook	24 00	23 00	24 00	1 10	05	2 50	47, 855 80
8	I. Y. Hoag, jr	20 00	15 00	20 00	1 50	03	2 00	49, 752 64
19	J[illegible]te, Barton & Crane	23 75	23 75	29 00	1 20	04	5 00	51, 214 87
21	H. S. Hopkins & Co	28 00	27 00	27 50	1 17	05	3 25	53, 870 01
46	Carmody & Mapel	28 50	28 50	30 00	1 20	†07 ‡06	1 75	54, 984 19
44	C. B. Willey	27 00	22 00	25 00	1 50	05	1 60	56, 555 17
17	R. G. Huston & Co	29 00	29 00	33 00	1 35	06	2 50	58, 646 02
41	P. Kendrick & Co	30 00	29 50	29 50	1 45	05	2 25	59, 809 22
24	L. Hommedieu & Bloom	33 00	33 00	33 00	1 50	04	4 00	64, 000 28
11	B. S. Howell	24 50	23 00	28 50	1 96½	04½	1 25	65, 702 78
20	Sheldon S. Eaton	30 00	26 00	33 00	2 00	05	2 00	70, 664 65
23	M. D. Burke & Co	30 00	28 00	35 00	2 00	05	2 00	71, 562 62
12	A. J. Jolley, Sons & Co	43 00	39 00	41 00	2 65	15	3 00	92, 409 13
10	C. J. McDonald & Co	43 00	27 00	43 00	2 87	03½	2 87	94, 526 85
18	A. B. Cole	27 49	25 49	25 49	4 70	02$\frac{85}{100}$	3 19	125, 028 55

*Informal. † Bolts. ‡ Spikes.

Contract awarded to John J. Shipman, and executed under date of November 28, 1884.

Owing to the late date at which the contract was awarded it was no practicable to procure the necessary timber in 1884, and nothing wa done until the spring of 1885. Work of construction was begun Ma 19, 1885, and at the close of the fiscal year the shore protection abou the root of the dike was finished, and the crib-work was completed an filled with stone for a distance of 450 feet. The total length of th dike is to be 2,500 feet.

The following materials were expended up to the close of the fisc year:

Oak timber	feet B. M.	80,000
Hemlock	do	70,000
Riprap-stone	cubic yards	9,133.2
Bolts and spikes	pounds	21,700
Brush	cords	276

Two hundred and twenty-three cubic yards of earth were excavate to secure a good foundation for the root or starting point.

ESTIMATE.

As the prices at which this work was let exceeded those on which th original estimate was based, as is shown by the abstract of proposals, and as experience acquired during the present season shows that the ba deepens from 2 to 3 feet in front of the advancing dike, an addition appropriation of $15,000 will be required to complete this work.

Money statement.

July 1, 1884, amount available		$15,937 0
Amount appropriated by act approved July 5, 1884		17,000 0
		32,937 0
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,753 16	
July 1, 1885, outstanding liabilities	5,717 23	
		13,470 3
July 1, 1885, amount available		19,466 6
Amount (estimated) required for completion of existing project		15,000 0
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 0

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

C C 10.

HARBOR OF REFUGE AT MOUTH OF GREAT KANAWHA RIVER, WEST VIRGINIA.

The river and harbor act approved July 5, 1884, allotted $15,000 for this work, of which $7,500 was to come from the appropriation for the Great Kanawha River and a similar amount from the appropriation for the Ohio River.

It was decided to build two ice-piers in the Great Kanawha River at a point about 1½ miles above its mouth, the piers being placed on opposite sides of the river.

Accordingly proposals were invited, by advertisement dated October 3, 1884, for furnishing material and constructing the piers. The following bids were received and opened on December 8, 1884:

Proposals for ice-piers at Point Pleasant, West Virginia.

No.	Bidders.	Material required.			Total cost.
		Price per M feet of oak (204,472 feet B. M.).	Price per cubic yard stone (2,486 cubic yards).	Price per pound drift-bolts (9,536 pounds).	
1	Porter, Tucker & Mahan	$26 66⅔	$0 73⅓	$0 05	$7,752 44
2	C. J. McDonald	23 00	1 25	03½	8,144 11
3	Wynne & Wisham	23 00	1 25	04	8,199 79
4	I. V. Hoag, jr	31 00	1 50	03	10,353 71
5	John Morgan	27 00	1 90	06	10,816 80
6	Ruffner & Grady	28 00	2 75	04	12,943 15
7	B. F. White & Son*	29 50	3 00	04½	13,919 08
8	Cofraw & Wilson	32 50	3 00	04	14,484 73
9	John S. Hogue	40 00	3 50	15	18,310 28

* Informal.

Contract was awarded to Porter, Tucker & Mahan, and executed under date of February 23, 1885.

These ice-piers will have a base of 46 feet by 30 feet and a top of 22 feet by 30 feet. The down-stream face will be vertical and the up-stream face will have a slope of 6 vertical on 5 horizontal. They will be built to a total height of 33 feet 3 inches above low water.

Owing to the lateness of the season work was not begun until May 21, 1885. At the close of the fiscal year the pier on the north side of the river was at a height of 24 feet 3 inches and filled with stone; the one on the south side was located June 28 and completed to a height of 15 feet 3 inches.

The following materials were expended in construction up to the close of the fiscal year:

Oak timber	feet B. M.	119,982
Riprap-stone	cubic yards	1,601
Bolts	pounds	5,500

Money statement.

Amount appropriated by act approved July 5, 1884		$15,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,643 52	
July 1, 1885, outstanding liabilities	2,275 06	
		4,918 58
July 1, 1885, amount available		10,081 42

C C 11.

PRELIMINARY EXAMINATION OF SHAWNEETOWN HARBOR AND LEVEE, ILLINOIS.

UNITED STATES ENGINEER'S OFFICE,
Cincinnati, Ohio, October 14, 1884.

GENERAL: In reply to so much of Department letter of July 31, 1884, as assigns to my charge the duty of making an examination or survey of "Shawneetown harbor and levee, Illinois," I would respectfully refer to my report on this subject, with map, dated May 17, 1884. Should any deficiencies be found in this report I shall be happy to supply them to the best of my ability.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
October 21, 1884.

Respectfully returned to Lieut. Col. William E. Merrill, Corps of Engineers, for a decided affirmative or negative opinion (as required by the last river and harbor act) whether the within locality is "worthy of improvement," and the cost of further survey, should you deem such necessary to supply any information in addition to that embraced in your report of May 17.

JOHN G. PARKE,
Acting Chief of Engineers.

[Second indorsement.]

UNITED STATES ENGINEER OFFICE,
Cincinnati, October 31, 1884.

Respectfully returned to the Chief of Engineers.

According to my understanding of the case, the people of Shawneetown wish protection from such floods as have recently overwhelmed them, and the "harbor" which they desire is such an elevation of the "levee" as will permit boats to land during floods. In all other cases on the Ohio River where the question of harbor has been involved, the desire has been to secure a greater depth *in low water.*

What is wanted, therefore, at Shawneetown is simply a levee against floods. If it is the intention of the Government to build levees around towns subject to inundation, then this locality is decidedly "worthy of improvement." If, however, the question turns solely on the wants of commerce on the Ohio River, I am under the necessity of stating that the interests of commerce would not be affected by the construction of a levee around Shawneetown, and, therefore, that from that point of view the harbor is not "worthy of improvement."

A high levee along the Shawneetown front would undoubtedly enable boats to land during great floods, but at such times the only business done on the Ohio River is the transport of supplies to inundated towns, a business which can hardly be classed as commerce.

No further examination or survey is necessary.

WM. E. MERRILL,
Lieut. Col. of Engineers.

C C 12.

PRELIMINARY EXAMINATION OF NEW ALBANY HARBOR, INDIANA, AND THE RIVER AND SHORES ADJACENT TO SAID HARBOR.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 14, 1884.

GENERAL: In accordance with instructions contained in Department letter of July 31, 1884, I have the honor to submit herewith the report of Lieut. Geo. W. Goethals, Corps of Engineers, on the preliminary examination of "New Albany Harbor, and the river and shores adjacent to said harbor, Indiana."

So far as I can learn, the result which it is desired to attain at this locality is the protection of a bank which is being washed away by the current. This is in itself a laudable object; but under the provisions of the river and harbor act, in which this examination is ordered, I consider it my duty to base my opinion as to whether a certain locality is worthy of improvement upon "the present and prospective demands of commerce"; and since it is evident to my mind that the commerce of the Ohio River has no interest in the protection of the river bank in question, I feel compelled to report that, from a commercial standpoint, this harbor is not "worthy of improvement."

It has been suggested that there is a probability of the river changing its channel, and making a cut-off through Middle Creek. I cannot see the slightest likelihood of such a change, as the route by way of Middle Creek is as long as the present channel, and there is therefore every inducement for the river to continue through the present open door rather than to batter down the side wall to make a new channel, neither shorter nor straighter than that in which it now flows.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF LIEUTENANT GEORGE W. GOETHALS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 11, 1884.

SIR: I have the honor to submit the following report on the preliminary examination made, in obedience to your orders, at New Albany, Ind.

Below this town are a few farms on the bottom lands, which are composed chiefly of alluvial deposits. The trouble is along the river bank, and arises from its being washed away by the action of the current when the water is high.

Above low water and under these deposits is a stratum of slate extending from above the town along the entire distance (about three-quarters of a mile) where erosion occurs, with the exception of a few hundred yards. The top of this stratum is from 8 to 10 feet above low water, and erosion begins at this level and continues throughout all the higher stages, the worse scour occurring when the water is about 20 feet high, or about 10 feet above the slate; from this point to the top the banks rise abruptly. The wash extends from the mouth of Falling Run, down stream for a distance of about three-quarters of a mile, and has been going on for the past ten or twelve years, but more noticeably within the last three. This increase has been attributed by some to the Portland Dike, and they claim that though this structure has accomplished the object for which it was built, and the channel never was so good as it is now, it throws the current with much more violence against their unprotected banks.

When the river is high enough to cover the bottom lands, it is stated that the force of the current sweeps over these lands from the mouth of Falling Run to Middle Creek, and it is anticipated that in time the soil will be entirely cut away, and the channel will then run in this direction instead of crossing to the Kentucky shore, as it does now.

What the farmers ask for is some protection from erosion. Commerce is not interfered with in this locality.

Very respectfully, your obedient servant,

GEO. W. GOETHALS,
First Lieut. of Engineers.

Lieut. Col. W. E. MERRILL,
Corps of Engineers, U. S. A.

C C 13.

PRELIMINARY EXAMINATION OF HARBOR AT PADUCAH, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 14, 1884.

GENERAL: In accordance with instructions contained in Department letter of July 31, 1884, I have the honor to submit herewith the report of Lieut. George W. Goethals, Corps of Engineers, on preliminary examination of "harbor at Paducah, Ky."

It has been suggested that the Ohio may cut through into the Tennessee at the "Sand Field," and thus lessen the protection now enjoyed at Paducah during ice floods. It does not seem to me that this is a serious matter, because ice floods are usually shorn of much of their violence before they reach the latitude of Paducah, and the Ohio already has free access to the Tennessee, above the Paducah landing, through the chute at the head of Tennessee Island. If a gap were made higher up the Tennessee it might not change the present comparative security from ice floods, and even if it did it would be an easy matter for boats to lie up in the Tennessee at some point above the sand field.

It will be observed that Lieutenant Goethals reports that the washing of the river bank at Paducah does not affect commerce. I concur in this opinion, and have, therefore, to report that, from a commercial standpoint, this harbor is not worthy of improvement.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF LIEUTENANT GEORGE W. GOETHALS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 11, 1884.

SIR: I have the honor to submit the following report on the preliminary examination, made in obedience to your orders, at Paducah, Ky.:

About 8 feet above low water the river bank in front of the upper part of this town, on the Tennessee River, is composed of a sort of quicksand, which being washed out by the current leaves the upper portion of the bank without support, causing it to cave in. About half a mile of the river bank is acted on in the manner above described. This scour has been continuing for some years, but the damage has been greatest during the past two high waters.

About half a mile above the end of Point Livingston (a narrow strip of land between the Ohio and the Tennessee) is a stretch of about 300 yards of sand, known as the Sand Field, which extends from the Ohio to the Tennessee. When the water is high and this Sand Field is covered, a strong current runs across from the Ohio, varying in velocity with the relative heights of the two rivers. It is feared by some that this current will in time wear this field away, and that the channel will run from the Ohio into the Tennessee at this point, and thus destroy the natural ice harbor which now exists at Paducah. The top of this field is now about 20 feet above low water.

The citizens ask for some protection against the erosion mentioned in the first paragraph.

The interests of commerce are in no way interfered with by this erosion.

Very respectfully, your obedient servant,

GEO. W. GOETHALS,
First Lieutenant of Engineers.

Lieut. Col. WM. E. MERRILL,
Corps of Engineers, U. S. A.

C C 14.

PRELIMINARY EXAMINATION OF HARBOR AT OWENSBORO', KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 14, 1884.

GENERAL: In accordance with instructions contained in Department letter of July 31, 1884, I have the honor to submit herewith the report of Lieut. George W. Goethals, Corps of Engineers, on the preliminary examination of "Harbor at Owensboro', Ky."

The unprotected river bank at this town is crumbling under the action of the current, and the citizens desire to have it protected by the General Government. By some the wash is attributed to the Government dike at Puppy Creek, 5 miles above, but I think the fact that the wash occurs at high water, when there is a depth of from 30 to 40 feet on the Puppy Creek dike, and also the fact that washing occurred before this dike was built, are sufficient to satisfy the unprejudiced mind that the dike in question is wholly innocent of action on the Owensboro' bank. Lieutenant Goethals states in his report that the wash of this bank has no injurious effect on commerce, and I concur in this opinion.

Inasmuch as I am required by law to judge of the worthiness of a harbor for improvement by the "present and prospective demands of commerce," I am under the necessity of stating that the harbor at Owensboro', Ky., is not "worthy of improvement."

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF LIEUTENANT GEORGE W. GOETHALS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 11, 1884.

SIR: I have the honor to submit the following report on the preliminary examination, made in obedience to your orders, at Owensboro', Ky.

The river bank in front of the town, beginning at the wharf and extending upstream for a distance of about 6,000 feet, is composed of coarse sand, at and above low water, then 8 to 15 feet of blue clay, then alternate strata of sand and blue clay to the top. Prior to the war the bank was protected by a growth of willows and cottonwoods, but when these were cut down the bank was left exposed and erosion began, and has continued ever since; but the rate of scour has, however, greatly increased during the last two high waters. The current alone does but little damage, but where assisted at high water by the wash of the waves, caused by the strong northwest winds which prevail in this locality, it washes out the sand, thus leaving the clay without support and causing it to cave in. The citizens ask for some protection against this erosion.

The old channel between Yellow Bank Island and the sand-bar below town is now impassable, and the bar and island are connected by a ridge of sand, and the present channel is down the Kentucky shore. It is claimed that the sand-bar is gradually extending down-stream towards the Kentucky shore, but I could not learn that the channel is in any way interfered with, for as this bar extends the Kentucky shore is cut out, so that the channel is preserved. In addition to the protection named in the first paragraph, the citizens of Owensboro' ask that a dike be built below the city so as to remove this bar and preserve their shore from this eroding action.

Commerce is not interfered with in this locality.

Very respectfully, your obedient servant,

GEO. W. GOETHALS,
First Lieutenant of Engineers.

Lieut. Col. WM. E. MERRILL,
Corps of Engineers, U. S. A.

C C 15.

PRELIMINARY EXAMINATION OF SCIOTO RIVER, OHIO.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 14, 1884.

GENERAL: In accordance with instructions contained in Department letter of July 31, 1884, I have the honor to submit herewith the report of Lieut. George W. Goethals, Corps of Engineers, on the preliminary examination of the Scioto River, Ohio.

The citizens of Portsmouth, Ohio, desire the creation of an ice-harbor in the mouth of the Scioto River. The commerce interested in the project is the local commerce of Portsmouth and all the transient commerce of the Upper Ohio. The value of this commerce is very great, although its amount cannot be definitely stated.

I agree with the conclusions of Lieutenant Goethals, and I have therefore to report that this harbor is "worthy of improvement." The cost of making the necessary survey of this locality is estimated at $1,065.

In reporting favorably upon this project, I merely indorse it as justifying a careful survey and study, even though the result may ultimately show the scheme to be impracticable.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF LIEUTENANT GEORGE W. GOETHALS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 13, 1884.

SIR: I have the honor to submit the following report on the preliminary examination made, in obedience to your orders, at Portsmouth, Ohio.

This town is situated at the mouth of the Scioto River, on the right bank of the Ohio, and it claims to be the head of navigation during low stages of water, on account of Bonanza Bar, in the river above. During the winter packets and barges passing up-stream and encountering ice, must, unless they are able to reach the mouth of the Big Sandy or the Great Kanawha, return to Portsmouth, where they lie up until the ice passes out. The number of boats remaining for the winter depends on the water and the season. The ice collects in the bend in the river above, and in time an ice-dam is formed across the Ohio, which gradually raises the level of the water above it until the resistance of the ice-dam is finally overcome, and the whole mass is pushed down-stream. When it reaches the mouth of the Scioto the conglomeration of water and ice rushes up this stream at the rate of from 7 to 10 miles per hour, bearing on with violence such barges from the wharf as have not been securely moored, and dashing them against the boats lying in the mouth of the Scioto, to the serious injury of both.

The damage in this locality caused by the ice averages yearly from five to six thousand dollars, and for this reason an ice-harbor is urgently requested. Such a place of refuge would not only be a protection to the commerce of Portsmouth, but will be a benefit to the whole commerce of the Ohio.

Two methods were suggested to prevent this damage. One was to build a suitable basin at the former mouth of the Scioto River, about 1½ miles below the present mouth, and connect it with the Ohio by locks, and possibly with the Scioto by canal. There is a natural depression in the ground adjacent to the old mouth, which, it was thought, might be used for the basin. There is water in the old bed when the river marks 15 feet at Portsmouth. The second method proposed was to build a dam across the Scioto about a quarter of a mile above its mouth, but not so high as to cause the overflow of the surrounding lands; 15 feet was suggested. By this means it was thought that the ice coming down the Scioto, in falling over the dam, would be broken into small enough pieces to cause no damage, while it would also prevent the strong current up-stream above referred to and boats could lie there securely all winter. It is stated that there is not less than 7 feet of water in the mouth of the Scioto during the winter.

As the whole commerce of the Ohio will be benefited by an ice harbor at Portsmouth, I would respectfully report that in my judgment the mouth of the Scioto is worthy of improvement, and I would therefore recommend that a detailed survey be made of the land adjacent to Portsmouth, including the present and former mouths of the Scioto.

The least amount of money necessary to make this survey and a plot of the same is $1,065.

Very respectfully, your obedient servant,

GEO. W. GOETHALS,
First Lieutenant of Engineers.

Lieut. Col. WILLIAM E. MERRILL,
Corps of Engineers, U. S. A.

SURVEY OF SCIOTO RIVER, OHIO.

UNITED STATES ENGINEER OFFICE,
Cincinnati, January 30, 1885.

GENERAL: I have the honor to submit the following report on the "Scioto River, Ohio," as required by the river and harbor act of July 5, 1884.

I found, on inquiry, that the object sought by the persons at whose instance this item was inserted in the river and harbor bill was the protection of the river commerce of Portsmouth during ice-floods, and that the only portion of the Scioto River which needed examination was its mouth. The survey was, therefore, limited to the present and the abandoned mouths of the Scioto River and their immediate surroundings, extending about 2 miles up the Scioto. This area is fully covered by the map* which accompanies this report.

Before discussing in detail the various projects which have been suggested, it is necessary to explain the past condition of affairs at this locality, and the great changes which have been effected by the hand of man.

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* Omitted.

Prior to 1830 the Scioto River emptied into the Ohio at the point now known as the "old mouth," and there was deep water along the whole front of Portsmouth, and as far down as the old mouth, a little more than a mile below the present mouth.

The Ohio Canal, which extends from Portsmouth to Cleveland, connecting the Ohio River with Lake Erie, was opened in 1832, though its connection with the Ohio was then unfinished. It had been the original intention to build locks at a point a short distance below the present elbow-lock, and then descend northwardly into the Scioto, which, at that time, ran near the northern side of the present lowest level of the canal, and parallel to it. A dam was to have been built across the Scioto at a point south of the same level, and the canal was to have terminated in the pool thus created.

Before work had been begun on the connection with the river the idea was conceived of cutting through the neck of the peninsula separating the lower section of the Scioto from the Ohio, and this cut was made in 1830. During the winter of 1830-'31 the Scioto poured through the cut, speedily adopting it as its mouth, and it remains as such to the present day.

In 1834, after the new mouth had become a fixed fact, outlet locks were built in the prolongation of the lower end of the canal. These locks could only be kept open by constant removal of deposits; but during the palmy days of the canal the revenues were ample, and the connection with the Scioto and the Ohio was kept in navigable condition. When railroads were generally introduced the business of the canal declined, and, finally, the revenues became so small that nothing could be spared for the removal of deposits, and the outlet was virtually abandoned. The locks and channel were once dredged out while the lessees were in possession of the State canals, but ultimately the effort to connect with the two rivers was abandoned, and the lower locks were suffered to fall into their present ruinous condition. It is now proposed to remove the "elbow" lock, raise the level below it, and terminate the canal with a waste weir, finally abandoning all thought of a connection with the Ohio.

Should the proposed ice-harbor basin be built the canal would probably be extended to the basin, and thus a connection with the Ohio would at last be secured by the route which should have been adopted from the beginning.

Before the cut was made the Scioto was very tortuous in its lower section, and there was good water for some distance up from its mouth. The radical change, caused by the cut, was followed by the abandonment of the bend north of the canal, and by a general straightening of the channel, by which it was greatly shortened, while at the same time the current was greatly accelerated, and was thus given a greatly increased capacity for scour. The exact amount of this shortening I cannot determine, but a sketch which I have received makes it a trifle less than 4 miles.

From the above it is clear that the bar now obstructing the mouth of the Scioto River is the direct consequence of a man's effort to improve on nature; and it is also clear that this effort has, in the present case, proved a lamentable failure. The sudden shortening of the stream caused a violent disturbance of its regimen, and a great increase in the amount of sand and gravel carried along in the shortened section. The earth and other materials which separated the Scioto from the Ohio were violently thrust into the latter, and to this mass was added the additional quantity of material brought down by the Scioto as the result of its increased current. The continued existence of this bar along a concave bank, where under other circumstances there would have been no bar and where none existed prior to the creation of the new mouth, proves that more drift and deposit have been thrown into the Ohio current than the latter could carry away. Appearances indicate that the Scioto has not yet settled down into a regular regimen, but replenishes the bar with new material about as rapidly as the Ohio cuts it down.

With every passing year the Scioto should regain more and more of its lost length, and its current should lessen, gradually approximating to the normal current that existed before the river was so greatly shortened. This decrease of current should reduce the quantity of sand and gravel carried into the Ohio, and the operation should continue until the acceleration due to the shortening had disappeared and the quantity of sediment thrust out by the river had fallen to what it was before the old mouth was cut off, at which time the amount did not exceed the carrying capacity of the Ohio, and there was no bar.

On the other hand, the natural increase in the area of cultivated land in the valley of the Scioto may have so increased the amount of sediment carried into the upper sections of the river, and thence into the lower section and into the Ohio, as to fully compensate for the diminished force of the cause that originally created the bar.

It is probable that the facts are as suggested above, and that this bar will not change materially, at least for many years, unless some outside power is invoked to assist the current of the Ohio.

I am satisfied that along the shore of the Ohio, below the mouth of the Scioto, the former depth could be restored by dredging away the bar which obstructs the mouth of the latter. It would not be necessary to dig away all of this bar, as the current of the Ohio would help the work materially after the dredges had broken up the nucleus of heavy material around which the lighter stuff is gathered. It is not to be expected that success could be obtained by one dredging, but the operation would probably require repetition in constantly diminishing degree until the lower section of the Scioto had become thoroughly scoured out; after that the Ohio would probably be able to care for the annual deposits. There seems every reason to believe that by steady work the mouth of the Scioto could be permanently deepened and made accessible in all stages of the Ohio.

The necessity of protection for river craft at Portsmouth is due to the fact that the Ohio has a habit of gorging along the river front until the mass of ice extends to the bottom of the river and becomes a veritable dam. Ultimately, of course, the gradual rise of the waters behind this dam (which I am informed sometimes amounts to as much as from 10 to 15 feet above the level of the water below) generates enough hydrostatic head to break the dam, and then a huge wave of water and ice rushes past the city, carrying everything before it. The effect of this wave is thus described by Capt. E. B. Moore:

> When the gorge moves past the mouth of the Scioto, the Ohio flows into and up the river so rapidly as to make it almost impossible to hold boats in the mouth of the river, drawing in old wrecks and everything near the shore with such force as to endanger boats moored there.

This action lasts until the force of the wave is lost by the filling up of the basin.

The cause of all the danger and loss at Portsmouth from ice-gorges is the bar in the Ohio at the mouth of the Scioto. In a private letter

Capt. E. B. Moore gives the following description of the action of this bar:

> The river here does not gorge until it gets down to 10 feet or less, at which stage the bar at and below the mouth of the Scioto River projects so far across the Ohio that there is not room for the large cakes of ice to pass, consequently it first stops there, then the ice from above crowds under and piles upon it, gradually building it up the river, until the pool in front of Portsmouth seems gorged almost to the bottom, forming a dam that raises the river many feet above its natural level at the wharf and for miles above. The river never gorges near here except at the Scioto Bar.

It is evident, from the above brief description of the action of the natural forces which endanger river craft at Portsmouth during the winter months, that the removal of the Scioto Bar is a necessity, and I therefore recommend that this be the first work undertaken at this locality.

It is probable, however, that the removal of this bar would not of itself give all the necessary relief, and therefore I will now take up and discuss the other methods that have been suggested. They are as follows:

(1) To construct a basin at the old mouth of the Scioto River, communicating with the Ohio by one or more locks.

(2) To build a dam, with lock, across the Scioto River near its mouth.

(3) To erect ice-piers at suitable points along the front of Portsmouth.

(4) To erect ice-piers at suitable points on the Kentucky shore opposite Portsmouth.

BASIN AT OLD MOUTH OF SCIOTO.

The distance between the old mouth and the present mouth of the Scioto is about 5,700 feet, and the bar which obstructs the latter extends down the Ohio only about 3,000 feet of this distance. There is good water in the Ohio at the old mouth, and it is proposed to build a lock at this point, and lock up into an artificial pool, to be created where there is now a crescent-shaped pond occupying a part of the old channel of the Scioto. The nearest point of this pond is 1,400 feet from the Ohio, and its surface is 13 feet above low water. It is evident, therefore, that we must either make a very deep and expensive excavation, or else must keep the surface of the basin at about the present level of the water, and provide a lock as a means of access. A low-water entrance channel and basin would be the more expensive of the two in original cost of excavation and in the annual cost of dredging. As a proof of this we need only refer to the existing condition of the old bed of the river. When the river left this bed the latter was rapidly filled by sediment to about its present height; but after this height had been attained annual floods had but little effect on raising the level.

These facts seem to show that a low-water basin and entrance would require a more frequent dredging than a basin and entrance at a higher level.

A basin at the present level of the pond would require a large and expensive lock, whose cost would nearly make up for the differences in the cost of excavation in the two projects, and this lock would require as frequent dredging as the low-water entrance-channel. This is conclusively shown by experience at the locks of the Louisville and Portland Canal.

As the majority of the parties in interest apparently desire a basin above low-water level, I shall confine my remarks to that project.

From a careful study of the letters contained in the pamphlet* of the

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* Omitted.

Portsmouth Ice-Harbor Association, of which a copy is hereto annexed, I find that the average of the various areas suggested as requisite for the basin is 20 acres, which area would give suitable accommodation for twenty steamboats and one hundred and fifty coal barges, with an allowance of 25 per cent. for passage-way. The peculiar shape of the low area to be utilized makes it unadvisable to excavate a basin with a greater width than 400 feet. An area of 400 by 2,200 feet would give a little more than the required 20 acres; but, as the shape of the old bed necessitates a curved basin, I have thought it advisable to compensate for this curvature by slightly increasing the length of the basin, and therefore the estimates have been made on a basin 400 feet wide and 2,500 feet long, with an entrance channel connecting the basin with the lock 100 feet wide and 750 feet long.

The total amount of excavation involved in this part of the project is 436,758 cubic yards. Assuming an average cost of 30 cents per cubic yard for both wet and dry excavation, we find that the cost of this item would be $131,027.

The banks of basin and entrance would require paving from 4 feet below the water-line to 10 feet above. This would amount to 22,400 square yards, which, at $1.25 per square yard, would cost about $28,000.

It is evident that the lock must have a lift of 13 feet, and it must be large enough to pass the largest steamboat that will ever wish to enter, besides being at least able to take in a first-class tow-boat and two barges. I conclude, therefore, that the width of the lock should be at least 56 feet and the available length at least 360 feet. Such a lock, founded on alluvial deposits, would cost about $250,000.

The level of water in the basin would have to be kept up by a supply sufficient to meet the consumption by lockage, evaporation, and leakage. The only available source is the Ohio Canal, whose surface at the elbow is 17 feet above the proposed basin. Should the latter be built, the State would probably connect the canal with the basin, and turn all the canal water into it without cost to the owners of the basin; otherwise, assuming that no charge were made for the water, an adequate connection, consisting of a pair of guard-gates and two masonry weirs, could be made for about $5,000.

An iron highway draw-bridge for the river road could be built at the lock for about $4,000,

A large and expensive lock cannot be abandoned to public use, but must necessarily have at least one lock-keeper; and it is also necessary that he should have a residence in the vicinity of the lock. A decent regard for health and comfort, and for safety in high floods, requires that the main floor of the house should be above the flood line of 1884. As this flood line at the old mouth of the Scioto was 35 feet above the top of the river bank, it is evident that the foundations of this house, which should be of masonry, must be at least 35 feet high. Under such circumstances, however cheap the superstructure, it is hardly possible to build this house for less than $6,000; and therefore I include this sum in my estimate.

Summing up the above items, we find the total cost of the basin scheme to be as follows:

Excavation	$131, 027
Paving	28, 000
Lock	250, 000
Water-supply	5, 000
Draw-bridge	4, 000
Lock-keeper's house	6, 000
Total	424, 027

In addition to this there must be an annual expenditure for the services of the lock-keeper, and for removing the deposits in the lock, which will be left by every rise in the river, and also an occasional expenditure for preserving the normal depth in the basin. These costs would have to be met by annual appropriations from Congress, as the board of public works of Ohio have insufficient funds to maintain even a narrow communication for canal-boats, and have abandoned the effort.

Besides the great cost of this project and the annual expenditure required for keeping it in working order, there are other objections to it which should be noted.

(1) If the Ohio Canal should be abandoned by the State (and such abandonment has been frequently threatened), the proposed ice-harbor would perish for lack of water. The only alternative would be to purchase the lower end of the canal and keep it up as a feeder.

(2) The ice-harbor and its lock would be closed by ice while the river was still in navigable condition. In the absence of current, it would be difficult to get rid of this ice, and it might be impossible on this account for boats to get into the harbor at the very time when it was needed.

(3) The capacity of a lock is limited, and three lockages an hour is about its maximum. In case of a sudden rush for the harbor, many boats would be unable to get into it.

(4) In a closely-crowded basin the danger of destruction by fire would be greatly increased.

For these reasons I cannot recommend the construction of the proposed ice-harbor.

LOCK AND DAM AT MOUTH OF SCIOTO.

I have no information as to whether or not a rock bottom is within reach at the mouth of the Scioto, but I am under the impression that rock cannot be found at an available depth. A lock to meet the requirements of the case should have the same capacity as the proposed lock at the old mouth, and it would cost about the same. A dam with masonry abutment on this soil would cost about $50,000, making the total cost of the work about $300,000. It would, of course, be possible to reduce the size of the lock, and thus reduce cost, but a small lock could not pass twenty steamboats and one hundred and fifty coal barges within a reasonable time; and in order to make a fair comparison between this project and the one contemplating a basin at the old mouth, it is essential that the inlet locks should have the same capacity.

In this project the difficulties from ice would be much reduced, as the pool could be broken up by boats, and the ice would pass over the dam.

If, however, the Scioto were very low, the depth on the crest of the dam might be too little, and in that case there would be trouble. In my judgment the removal of the Scioto Bar would ultimately deepen the present mouth, and thus create an open ice-harbor, accessible at all times, which would be much more useful than the proposed artificial one. For this reason, and on account of its great cost and limited usefulness, I cannot recommend this project.

ICE-PIERS IN PORTSMOUTH HARBOR.

Structures of this kind are the means generally employed to secure protection from ice, and as a rule they have proved efficacious. The objection to their construction by the United States, along shores that are used for commercial purposes, is, that they constitute an improvement of private property at Government expense. I have uniformly taken this view in all previous reports of this kind, and I see no reason to change it now. I think it would be advantageous to commerce if owners of landings along the front of Portsmouth were to build such piers at their own cost, for the protection of river craft using these landings; but I do not think that they should be built by the United States.

ICE-PIERS OPPOSITE PORTSMOUTH.

The Kentucky shore opposite Portsmouth affords favorable sites for ice-piers, and it is believed that ice-harbors created on this shore by such piers would present many advantages over any of the projects hitherto discussed. They would be readily accessible as soon as the ice became threatening; all of them could be occupied at once with the minimum loss of time; there would be no expense of maintenance, except occasional repairs; there would be no unusual risk of fire, and these harbors would occupy ground not used for wharf purposes. Of the four projects discussed this is the one which I would recommend. Each ice-harbor would be formed by two ice-piers with an opening between them. Three pairs of such piers would probably suffice for the present.

I estimate that each pair of piers would cost $9,000, and that the total cost would be $27,000.

I would also recommend an appropriation of $20,000 for dredging off the bar at the mouth of the Scioto.

The total estimate is therefore as follows:

For six ice-piers	$27,000
For dredging	20,000
Total	47,000

Respectfully submitted.

WM. E. MERRILL,
Lieut. Col. Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

C C 16.

PRELIMINARY EXAMINATION OF LAWRENCEBURG HARBOR, INDIANA.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 7, 1884.

GENERAL: In accordance with instructions contained in Department letter of July 31, 1884, I have the honor to submit the following report on the preliminary examination of "Lawrenceburg Harbor, Indiana."

Lawrenceburg is situated at the mouth of the Great Miami, and I am informed that the object of this survey is to devise some plan for improving the low-water depth in the Ohio, and at the same time to discuss the effects of the recent great floods on the channel of the Ohio in this vicinity.

This survey should extend over a distance of 5 miles of the Ohio and 2 miles of the Great Miami, and its cost, including project, estimate for improvement, and necessary information, will be about $1,000.

The commerce interested in this improvement is the greater portion of the commerce of the Ohio River, and I would respectfully refer to my last annual report for such statistics as were attainable regarding the same.

The locality is worthy of improvement.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

SURVEY OF LAWRENCEBURG HARBOR, INDIANA.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, January 20, 1885.

GENERAL: The river and harbor act approved July 5, 1884, among other surveys and examinations, orders one of "Lawrenceburg Harbor, Indiana."

I have received no official instructions as to the precise points to be developed by this survey, but the memorial* of the manufacturers and shippers of Lawrenceburg, hereto annexed, states that recent floods have greatly injured their harbor, and calls upon the United States to intervene for the following reasons:

(1) The February floods of the last three years show that new hygrometric conditions prevail in the Ohio Valley, indicating a return to the excessive rainfalls of prehistoric times.

(2) The Ohio River once followed the bed of Tanner's Creek, crossed its present bed near Petersburg, and passed through a slough running nearly south across the Kentucky Bottoms at a point about 1 mile east of Aurora.

(3) The shoaling of Lawrenceburg Harbor is due to these floods, and measures should be taken to prevent it. Moreover, the flood currents show a tendency to cut through between Lawrenceburg and Newtown, and if this should actually occur the navigation of the Ohio River at this locality would be more obstructed than it is at present.

In reply to the above I would state that the great gravel-bed of the Ohio Valley, locally known as the "second bank," must have been deposited when the river surface was habitually higher than the present level of the top of this bank. At Cincinnati the great flood of 1884 lacked 40 feet of coming up to the top of this bank, and hence this flood must have been more than 40 feet below the prehistoric floods which deposited these banks. The amount of water that would have been required to raise the flood level of 1884 40 feet higher is so enormous that I am forced to conclude that, although we may, from time to time, be subject to inundations, some of which may even exceed the hitherto unprecedented flood of 1884, there is yet no present indication of a return to anything like the excessive rainfall and floods which prevailed during the deposit of the high gravel banks of the Ohio Valley.

To the assertion that the channel of the Ohio River once followed Tanner's Creek and the slough on the Kentucky shore, I can only answer that I cannot see any evidence in its favor. The slough below Petersburg is from 200 to 400 feet wide, and had only about 10 feet of water in it during the great flood of 1884. As there was at this time 10 feet of water on the highest part of Lawrenceburg (excluding Newtown), it is evident that any conclusion from present conditions that the old channel of the Ohio once occupied the site of the slough would necessitate the same conclusion as to the site of Lawrenceburg. If, therefore, we conclude that prehistoric conditions are likely to return, we must also conclude that it will be necessary to abandon the site of the town, as it would manifestly be hopeless to attempt to levee it against prehistoric floods.

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* Omitted; printed in House Ex. Doc. No. 154, Forty-eighth Congress, second session.

It is a well-known law of hydraulics that as a river increases in size it ignores the bends and curves of low water, and with each increment of supply it loses more and more of its curvature, swinging with grand sweeps from one bend to the next. As it rises over its banks the influence of the latter disappears, and the current still further straightens itself by cutting across points. This is doubtless the cause of the existence of the high-water slough below Petersburg. The slough, or low valley, between Lawrenceburg and Newtown is due to the fact that when the Ohio is in flood it drives back the water of the Great Miami from its present mouth and compels the latter to discharge between Lawrenceburg and Newtown, thus creating a temporary high-water channel through this interval.

Such high-water channels are very common on the Mississippi, where the softness of the soil permits the stream to develop to their utmost limits the normal results of floods, and yet these sloughs never become the main channel, notwithstanding the fact that they are usually shorter than the channel. When the flood subsides, the sloughs are found to be either unchanged or else reduced in size by sediment and drift. Long ages before the settlement of Lawrenceburg the slough between it and Newtown had taken its present width and depth, its size and shape being the resultant of all the forces, both of scour and deposit, which habitually act upon it. Unless there should, in the future, be a marked change in the regimen of the two rivers which have created this slough, there is little likelihood of a change in its dimensions.

As the town of Lawrenceburg grows in size and the houses increase in number there will be less and less room at this point for the discharge of the Great Miami water during floods in the Ohio, and the current through the slough would naturally increase in velocity, and increased velocity means increased capacity for enlarging its channel by scour. But it must not be overlooked that as the town grows in size, so will also grow the necessity for embankments across this slough. These embankments will do more to check the flow than the increase of buildings in the town will do to accelerate it. The current over these embankments, whenever they are overtopped, will be swift, as was the case last February, but the total flow through the slough must necessarily be lessened, and therefore there should be no tendency to scour. I examined this ground very carefully after the flood of 1884 had subsided, and, while I found that both of the railroad embankments had been broken, and that the upper causeway had been severely washed, I failed to see any indication that the slough itself was either widening or deepening.

The map accompanying this report shows that in great floods the river above Lawrenceburg is about 2¼ miles wide, while it is only 1¼ miles between flood lines at Lawrenceburg, and much of this distance is obstructed by buildings.

Were the town of Lawrenceburg surrounded by an insubmersible levee, the space for the passage of floods would be reduced to 1,700 feet, as the hills on the Kentucky shore come down to the river bank. Such a contraction would undoubtedly increase the river current and bring a heavy pressure against levees that might be built; but, on the other hand, it is undoubtedly possible to build levees which would resist these forces; it is merely a question of cost.

These physical conditions show very forcibly why Lawrenceburg suffers so much from inundation, and why the currents through the streets are so much fiercer than elsewhere.

At Aurora, 4 miles below Lawrenceburg, the flood width of the river (excluding the slough on the Kentucky side) was 2,900 feet; a quarter of a mile below Aurora the flood width was exactly half a mile.

The harbor of Lawrenceburg is undoubtedly in need of improvement, but the shoalness of the water cannot be wholly due to the floods of 1883 and 1884, as I have personally known this locality as a shallow place in low water ever since I took charge of the improvement of the Ohio River, in 1870; and while it may have been more shallow than usual in 1884, the flood can only be held responsible for aggravating a condition which was bad when it arrived.

After a careful study of the situation, I am of the opinion that the chief cause of the shallow water at Lawrenceburg is the huge bar at the mouth of the Great Miami, 1¾ miles above the town. If this bar did not exist there would probably be deep water along the Lawrenceburg front, as the town is situated on the concave bank of the river. The unusual shoalness observed during the low water of 1884 is coincident with an unusual protrusion of this bar.

It is, therefore, my conclusion that the first step to be taken in the improvement of Lawrenceburg Harbor is to remove the projecting bar at the mouth of the Great Miami, and give the current of the Ohio a free sweep along the front of Lawrenceburg. It is possible that after this bar is removed there may yet remain other work to be done before the low-water depth in front of the town will be satisfactory; but as the removal of this bar is clearly imperative, it seems judicious to limit our present efforts to what is certain, and to await its results before planning any additional works.

It is impossible to make a close estimate of the cost of this work, as the bar varies in size from year to year, and the amount of aid that will be given by the current is uncertain. I therefore submit an approximate estimate of $20,000.

Our surveys show that the harbor of Aurora is in good condition, and apparently needs no work. I would recommend that the owners of the land on the Kentucky point below Petersburg, on which is found the high-water chute, keep this chute filled with growing trees and bushes, so as to protect the soil and catch sediment during floods. If this precaution be taken there is no danger of the chute either deepening or widening. There is, in my judgment, no present need for the intervention of the United States.

In the above report I have made no estimate of the cost of building a levee around Lawrenceburg, for the reason that in my opinion the construction of such a levee would not improve the navigation of the Ohio River. The town is greatly in need of protection of some kind against floods, and if the Government contemplates erecting levees around towns liable to inundation, I know of no case more deserving of such protection; but as I understand my present instructions, I consider it my duty to report on all projects from the single standpoint of the *interests of navigation;* and I am reluctantly compelled to express the opinion that the interests of navigation are not concerned in the protection of Lawrenceburg from floods.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

C C 17.

PRELIMINARY EXAMINATION OF THE BAR IN THE OHIO RIVER OPPOSITE THE MOUTH OF THE LICKING RIVER, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 7, 1884.

GENERAL: I have the honor to submit the following report upon the preliminary examination of "the bar in the Ohio River opposite the mouth of the Licking River, to determine the cost and practicability of removing or making a navigable channel through the same." * * *

The lower 3 miles of the Licking River is really a part of the harbor of Cincinnati, and it is important to the whole commerce of that city that access to this river should be unobstructed at all stages. It is now impossible for boats to enter the Licking during low water, on account of a rock-bar, a large portion of which becomes dry in extreme low water. For the amount of the commerce of this port which is interested in this improvement I would respectfully refer to my last annual report.

I have, therefore, to report that this locality is worthy of improvement, and I would submit an estimate of $300 as the least sum which will enable me to make the survey contemplated by the river and harbor act, including the project, the estimate for improvement, and the information required to be furnished.

Respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

SURVEY OF THE BAR IN THE OHIO RIVER OPPOSITE THE MOUTH OF THE LICKING RIVER, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, February 7, 1885.

GENERAL: I have the honor to submit the following report on the bar in the Ohio River at the mouth of the Licking.

The river and harbor act of July 5, 1884, ordered this survey in the following language:

> For examination and survey of the bar in the Ohio River opposite the mouth of the Licking River, to determine the cost and practicability of removing or making a navigable channel through the same; and the engineer in charge shall report whether it is practicable to connect the navigation of the Licking River with the Ohio River without the removal of the said bar, or making a channel through the same.

In the paragraph just quoted three questions are involved, which will be discussed in their order:

1. The practicability of removing the bar in question, or of making a channel through it.

In reply I would state that the bar that obstructs the mouth of the Licking extends up-stream to York street in Newport, and its down-stream point is at the southern pier of the Covington and Cincinnati Suspension Bridge. It consists of limestone rock *in situ*, covered in part by loose rock and gravel. The total area of this bar is about forty-eight acres, and it projects toward the Ohio shore more than half the low-water width of the river, leaving a narrow but deep channel on the Cincinnati side.

The total removal of this bar would be very costly, and there is no good reason for undertaking such a work. It operates to keep the low-water channel on the Cincinnati side, where it ought to be, and any radical change in existing conditions would be injurious to commerce.

On the other hand, it is both practicable and advisable to cut a channel through this bar into the Licking River, as the latter stream is much used during ice-floods as a harbor of refuge, and at all times for harboring coal barges; moreover, its banks are lined with manufacturing establishments that need free communication with the Ohio at all stages of the latter.

2. The cost of making a channel through this bar.

There are two ways in which this work can be done. One is to surround by coffer-dams a given portion of the area to be excavated, and, after pumping out the water, to blast out the rock in the usual way. By repeating this operations until the whole area has been treated in this manner, we ultimately obtain a channel of exactly the required width and depth, and we remove no more rock than is absolutely necessary. The objections to this method are that it is very costly; it can only be carried on in low water; it requires many seasons of work before it can be completed, and the coffer-dams are serious obstructions to navigation while the work is in progress. The stage of the river at Cincinnati is so variable that during some seasons no work might be possible, and during others sudden rises in either river might destroy the coffer-dam and entail heavy expense. A contractor can only guard against such contingencies by heavily loading his estimates of net cost.

For the same reason an engineer can only make approximate estimates of the cost of doing the work in this manner. After careful investigation, I put the probable cost of obtaining by this method a channel with 4 feet depth in low water at $150,000.

The other way is to drill holes from a flat-boat in a prescribed order, blast them out with dynamite discharged by an electric current, and subsequently to remove the débris by dredging. This is both quicker and cheaper than the other method, notwithstanding the fact that the excavation must go deeper, in order to be sure of securing the depth required. The chief advantage is that navigation is not obstructed during the progress of the work, and floods do no injury.

I would estimate the cost of blasting out a 4-foot channel by this method at $75,000, and would recommend that the plan herein outlined be adopted for the work.

3. The practicability of connecting the navigation of the Licking River with the Ohio without the removal of the said bar or making a channel through the same.

To this I would reply that the navigation of these two streams cannot be connected in low water without the removal of this bar.

I inclose herewith a map* of the locality.

Respectfully submitted.

WM. E. MERRILL,
Lieut. Col. Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

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* Omitted.

APPENDIX D D.

IMPROVEMENT OF GREAT KANAWHA AND ELK RIVERS, WEST VIRGINIA AND OF NEW RIVER IN VIRGINIA AND WEST VIRGINIA.

REPORT OF LIEUTENANT-COLONEL WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Great Kanawha River, West Virginia.
2. Elk River, West Virginia.
3. New River, from the Mouth of Wilson, in Grayson County, Virginia, to the mouth of Greenbrier River, West Virginia.
4. Examination of models and plans, &c., for movable dams.

EXAMINATION.

5. Greenbrier River, West Virginia.

(For letter of transmittal see Appendix I.)

D D 1.

IMPROVEMENT OF THE GREAT KANAWHA RIVER, WEST VIRGINIA.

The object of the improvement has been to give a depth of not less than 6 feet all the year round throughout the whole river, 96 miles. The means are locks and dams. The locks are about 350 by 50 feet in the clear. The following table shows the present condition:

No.	Distance in miles from Charleston.	Style of dam.	Remarks.
2	26½ miles above	Fixed	Lock in progress of construction under contract; dam not commenced.
3	21 miles above	Fixed	In operation.
4	15 miles above	Movable	In operation.
5	9 miles above	Movable	In operation.
6	4 miles below	Movable	Lock completed; dam under contract.

One more site is to be occupied above and six below, but the portion of the river (about one-third) on which work is now complete or in progress is that which needed it most. Some dredging is also required in the pools, as well as the removal of snags and rocks.

If there had been an appropriation at the session of Congress of 1884–'85, the completion of Dam 2 would have been assured in 1885, a very important step in the improvement. Work could also have been commenced at Site 7 or 1, or both. Unless the next appropriation be early in the session of 1885–'86, the completion of Dam 2 and operations of any extent at 7 and 1 cannot be expected until 1887.

Mr. A. M. Scott has continued to exercise the local charge in his usual efficient manner. His report, which is appended, treats in detail of the operations of the year.

The United States land at Site 6, abutment side, has been more than two years crossed without proper authority by the track of the Ohio Central Railroad Company, which extends from Charleston along the right bank of the Kanawha River to its mouth. It is supposed the crossing can be really authorized only by Congress. It is just to state that while this is technically a trespass no absolute injury has thus far resulted to the United States, and it is supposed that by restoring the fences which bound the site the crossing could be stopped. The railroad is now in the hands of a receiver. The attorneys promised to make an effort to obtain from Congress at the last session a proper authority for the crossing, but no such permission was granted.

As the improvement of the river has progressed, the commerce on it, notably the shipment of coal, has greatly increased. This has not been to the disadvantage of the Chesapeake and Ohio Railroad, as some supposed would be the case, for the statistics show an increase in the coal business of that highway of trade and travel; the full advantage of the improvement cannot be realized until it be complete.

The telephone line has been maintained between the central office in Charleston and the locks, and is used by night as well as by day, being found indispensable for the proper oversight and direction of operations as well of construction as of maintenance.

A gauge-reader has been kept at Kanawha Falls, near which place the Gauley joins the New to form the Great Kanawha River; and another at Hinton, where the Greenbrier empties into the New River. The compensation of these men is but $10 a month each. They send to the central office daily reports by postal card of the stage of the river at their respective stations, and by telegraph when there is a rapid rise. These reports are necessary as warnings to the central office in Charleston, in order that such maneuvers of the dams, &c., may be had in time as the height and duration of the freshets may require.

For perfect security a similar station should be occupied at some point on the Upper Gauley, and perhaps also on the Elk, when No. 6 Dam is completed.

Money statement.

July 1, 1884, amount available		$126,260 85
Amount appropriated by act approved July 5, 1884		200,000 00
		326,260 85
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$122,348 27	
July 1, 1885, outstanding liabilities	14,567 57	
		136,915 84
July 1, 1885, amount available		189,345 01

Amount (estimated) required for completion of existing project	$1,857,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1877	500,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

OPERATING AND KEEPING IN REPAIR THE LOCKS AND DAMS ON THE GREAT KANAWHA RIVER, WEST VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., July 27, 1885.

GENERAL: Since the receipt of your authority of August 15, 1884, the expense of operating the locks and dams on the Great Kanawha River in West Virginia has been paid in the manner indicated by section 4, act of July 5, 1884.

In compliance with the proviso to that section which requires the rendition of an itemized statement of such expenses, I have the honor to forward the inclosed paper.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

STATEMENT OF AMOUNT EXPENDED DURING THE FISCAL YEAR ENDING JUNE 30, 1885, OUT OF THE GENERAL APPROPRIATION FOR "OPERATING AND CARE OF CANALS AND OTHER WORKS OF NAVIGATION," IN OPERATING AND KEEPING IN REPAIR THE LOCKS AND DAMS ON THE GREAT KANAWHA RIVER, WEST VIRGINIA.

Lock and Dam No. 3:		
For pay of lock hands and extra labor	$1,907 82	
For repairs, material for, &c	29 59	
For supplies, as oils, fuel, tools, &c	41 72	
For freights and transportation	3 75	
		$1,982 88
Lock and Dam No. 4:		
For pay of lock hands and extra labor	1,623 70	
For repairs, materials for, &c	76 36	
For supplies, as oils, fuel, tools, &c	39 82	
For freights and transportation	4 05	
		1,743 93
Lock and Dam No. 5:		
For pay of lock hands and extra labor	1,671 02	
For repairs, materials for, &c	86 44	
For supplies, as oils, fuel, tools, &c	68 79	
For freights and transportation	2 50	
		1,828 75
Lock and Dam No. 6:		
For pay of watchman and extra labor		52 55
Telephone:		
For pay of rent	48 35	
For repairs	2 00	
For supplies	3 05	
		53 40
Gauge-keepers:		
For pay of gauge-keepers and reporters at Hinton and Kanawha Falls.		60 00
Steamer Bee:		
For part of running expenses of steamer Bee		90 00
Total		5,811 51

Abstract of proposals for building the foundations and the pier and abutment of Dam No. 6, Great Kanawha River, West Virginia, opened at 12.5 p. m., August 25, 1884.

Work and materials.	Approximate quantities.	No. 1.		No. 2.		No. 3.		No. 4.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
Excavation, per cubic yard	11,000	$1 00	$11,000 00	$1 00	$11,000 00	$0 65	$7,150	$0 90	$9,900
Excavation, rock, per cubic yard	400	2 00	800 00	4 00	1,600 00	2 00	800	2 50	1,000
Embankment, in place, per cubic yard	500	50	250 00	50	250 00	50	250	35	175
Pudling, in place, per cubic yard	950	75	712 50	1 25	1,187 50	1 00	950	1 50	1,425
Concrete, in place, per cubic yard	2,400	7 00	16,800 00	10 00	24,000 00	6 00	14,400	8 00	19,200
Rock-face masonry, in place, per cubic yard	1,900	12 00	22,800 00	11 50	21,850 00	11 00	20,900	10 50	19,950
Pointed-face masonry, in place, per cubic yard	540	13 25	7,155 00	18 00	9,720 00	13 00	7,020	12 00	6,480
Cut-stone masonry, in place, per cubic yard	40	15 00	600 00	20 00	800 00	18 00	720	30 00	1,200
Sills, in place, per cubic yard	290	16 00	4,640 00	30 00	8,700 00	18 00	5,220	30 00	8,700
Coping, in place, per cubic yard	450	16 00	7,200 00	25 00	11,250 00	18 00	8,100	27 00	12,150
Riprap, in place, per cubic yard	800	2 00	1,600 00	3 00	2,400 00	1 80	1,440	3 50	2,800
Timber, in place, in permanent construction, per 1,000 feet B. M.	87,000	49 00	4,263 00	75 00	6,525 60	40 00	3,480	70 00	6,090
Bolt-holes drilled, per linear foot	3,800	30	1,140 00	1 00	3,800 00	50	1,900	50	1,900
Crib-logs in coffer-dam, per linear foot	87,000	18	15,660 00	30	26,100 00	45	39,150	30	26,100
Coffer dam sheathing, per 1,000 feet B. M	48,000	30 00	1,440 00	40 00	1,920 00	35 00	1,680	40 00	1,920
Coffer-dam filling, per cubic yard	10,000	60	6,000 00	50	5,000 00	1 00	10,000	1 00	10,000
Total	......	....	102,060 50	......	136,102 50	......	123,160	......	128,990

RECAPITULATION.

No. 1.	*Harold & McDonald & Co., Pittsburgh, Pa.	$102,060 50
No. 2.	Keefer & Dull, Lewiston, Pa	136,102 50
No. 3.	M. D. Burke, Cincinnati, Ohio	123,160 00
No. 4.	J. H. Wingate, Wytheville, Va	128,990 00

Abstract of proposals for the iron work in the foundation of Dam No. 6, Great Kanawha River, opened at the United States Engineer Office, Charleston, W. Va., at 12 m., December 2, 1884.

No.	Names and addresses of bidders.	Wrought iron (21,300 pounds).		Drift-bolts and dowels (12,500 pounds).		Cast iron (33,300 pounds).		Total.
		Per pound.	Amount.	Per pound.	Amount.	Per pound.	Amount.	
		Cents.		*Cents.*		*Cents.*		
1	†O. A. and W. T. Thayer, Charleston, W. Va	4.25	$905 25	3	$375 00	2.75	$915 75	$2,196 00
2	John C. Froehlick & Co., Baltimore, Md	8.25	1,757 25	4.50	562 50	2.6	865 80	3,185 55
3	H. A. Ramsey & Son, Baltimore, Md	5.95	1,267 35	3.75	468.75	3.25	1,082 25	2,818 35
4	The Snead & Co. Iron Works, Louisville, Ky	5.08	1,082 04	3.27	408 75	2.34	779 22	2,270 01
5	Morris & Marshall, Pittsburgh, Pa	4⅜	931 87	4⅜	546 87	3.50	1,165 50	2,644 24
6	Vulcan Machine Company, Middleport, Ohio	4.07	866 91	2⅞	359 37	3	999 00	2,225 28
7	Enos, Hill & Co., Gallipolis, Ohio	5.50	1,171 50	3	375 00	2.50	832 50	2,379 00
8	Colwell Iron Works, New York, N. Y.	4.84	1,030 92	3.91	468 75	2.95	982 35	2,502 02
9	‡W. F. Robinson & Co., Farmer, Ohio	4.75	1,011 75	3.25	406 25	2.25	749 25	2,167 25

*Contract with Harold & McDonald.
†Contract with O. A. and W. T. Thayer.
‡Informal.

Abstract of proposals for furnishing Lock No. 2, Great Kanawha River improvement, opened at United States Engineer Office, Charleston, Kanawha County, West Virginia, at 12.10 p. m., February 3, 1885, by Lieut. Col. William P. Craighill, Corps of Engineers.

Work and materials.	No. 1.		No. 2.		No. 3.	
	Harold & McDonald.		Hogg, Petitdidier & Le Duke.		Ruffner & Grady.	
	Price per unit.	Amount.	Price per unit.	Amount.	Price per unit.	Amount.
700 cubic yards excavation, per cubic yard	$1 00	$700 00	$0 60	$420 00	$0 50	$350 00
10,800 cubic yards embankment in place, per cubic yard	75	8,100 00	50	5,400 00	50	5,400 00
100 cubic yards puddling in place, per cubic yard	3 00	300 00	1 00	100 00	1 00	100 00
3,140 cubic yards backing masonry in place, per cubic yard	9 75	30,615 00	7 50	23,550 00	8 00	25,120 00
900 cubic yards rock face in place, per cubic yard	12 00	10,800 00	11 00	9,900 00	10 00	9,000 00
880 cubic yards pointed face in place, per cubic yard	14 00	12,320 00	12 00	10,560 00	11 50	10,120 00
460 cubic yards cut stone in place, per cubic yard	15 50	7,590 00	13 50	6,210 00	18 00	8,280 00
58 cubic yards quoins in place, per cubic yard	25 00	1,450 00	19 00	1,102 00	23 00	1,334 00
375 cubic yards coping in place, per cubic yard	17 00	6,375 00	19 00	7,125 00	23 00	8,625 00
925 cubic yards paving in place, per cubic yard	7 50	6,937 50	4 00	3,700 00	5 00	4,625 00
670 cubic yards riprap, hand placed, per cubic yard	3 90	2,613 00	2 00	1,340 00	2 50	1,675 00
1,400 cubic yards stone filling, per cubic yard	1 80	2,520 00	1 00	1,400 00	1 50	2,100 00
30,000 feet of timber, placed, per 1,000 feet B. M.	36 00	1,080 00	30 00	900 00	35 00	1,050 00
570 linear feet bolt holes, per linear foot	25	142 50	60	342 00	75	427 50
Totals	....	91,543 00	....	72,049 00	....	78,206 50

Work and materials.	No. 4.		No. 5.		No. 6.	
	Frank Hefright.		Thomas Croghan.		* Chas. H. Strong & Son.	
	Price per unit.	Amount.	Price per unit.	Amount.	Price per unit.	Amount.
700 cubic yards excavation, per cubic yard	$0 50	$350 00	$0 50	$350 00	$0 75	$525 00
10,800 cubic yards embankment in place, per cubic yard	50	5,400 00	60	6,480 00	28	3,024 00
100 cubic yards puddling in place, per cubic yard	50	50 00	1 00	100 00	80	80 00
3,140 cubic yards backing masonry in place, per cubic yard	11 00	34,540 00	7 75	24,335 00	6 00	18,840 00
900 cubic yards rock face in place, per cubic yard	11 00	9,900 00	10 50	9,450 00	9 50	8,550 00
880 cubic yards pointed face in place, per cubic yard	11 00	9,680 00	12 50	11,000 00	11 00	9,680 00
460 cubic yards cut stone in place, per cubic yard	11 00	5,060 00	15 00	6,900 00	16 50	7,590 00
58 cubic yards quoins in place, per cubic yard	11 00	638 00	21 00	1,218 00	22 00	1,276 00
375 cubic yards coping in place, per cubic yard	11 00	4,125 00	20 00	7,500 00	28 00	10,500 00
925 cubic yards paving in place, per cubic yard	5 50	5,087 50	5 00	4,625 00	4 50	4,162 50
670 cubic yards riprap, hand placed, per cubic yard	5 00	3,350 00	3 75	2,512 50	1 40	938 00
1,400 cubic yards stone filling, per cubic yard	2 50	3,500 00	1 75	2,450 00	1 40	1,960 00
30,000 feet timber, placed, per 1,000 feet B. M.	50 00	1,500 00	31 00	930 00	30 00	900 00
570 linear feet bolt holes, per linear foot	40	228 00	35	199 50	20	114 00
Totals	....	83,408 50	....	78,050 00	......	68,139 50

* Contract with Charles H. Strong & Son.

Abstract of proposals for iron work of navigation pass, Dam No. 6, *Great Kanawha River, West Virginia, opened at United States Engineer Office, Charleston, W. Va., at* 12 *m., February* 14, 1885.

No.	Names and addresses of bidders.	Wrought iron (130,000 pounds).		Cast iron (97,000 pounds).		Total.
		Per pound.	Amount.	Per pound.	Amount.	
		Cents.		*Cents.*		
1	Pittsburgh Bridge Company, Pittsburgh Pa	5.90	$7,670 00	3.25	$3,152 50	$10,822 50
2	Scaife Foundry and Machine Company, limited, Pittsburg, Pa	10	13,000 00	5	4,850 00	17,850 00
3	T. H. & W. J. Carlin, trustees, Allegheny City, Pa	....	....	3.8	3,686 00	3,686 00
4	*The Snead and Company Iron Works, Louisville, Ky	5.81	7,553 00	2.94	2,851 80	10,404 80
5	The Tredegar Company, Richmond, Va	8	10,400 00	3.5	3,395 00	13,795 00
6	Queen City Bridge and Steam Forging Company, Cincinnati, Ohio	6.5	8,450 00	2.75	2,667 50	11,117 50
7	The H. A. Ramsey Engineering Works, Baltimore, Md.†	7.45	9,685 00	3.95	3,831 50	13,516 50

* Contract with the Snead and Company Iron Works.
† Received and opened at 4 p. m., February 14, 1885.

Abstract of proposals for irons for Lock No. 2, *Great Kanawha River improvement, opened at the United States engineer office, at Charleston, Kanawha County, W. Va., May* 19, 1885.

No.	Names and addresses of bidders.	Wrought iron (15,500 pounds).		Cast iron (7,400 pounds).		Total.
		Per pound.	Amount.	Per pound.	Amount.	
		Cents.		*Cents.*		
1	Lambert Bros. & Co., Ironton, Ohio	7.25	$1,123 75	3.85	$284 90	$1,408 65
2	Queen City Bridge and Steam Forging Company, Cincinnati, Ohio	5.9	914 50	3.75	277 50	1,192 00
3	Riter & Conley, Pittsburgh, Pa. (not signed)	8.25	1,278 75	6.55	484 70	1,763 45
4	The Snead and Company Iron Works, Louisville, Ky.*	3.8	589 00	4.32	319 68	908 68
5	William B. Scaife & Sons, Pittsburgh, Pa	7.8	1,209 00	5.75	425 50	1,634 50
6	Erno Hill & Co., Gallipolis, Ohio	8	1,240 00	3.5	259 00	1,499 00
7	Portsmouth Foundry and Machine Works, Portsmouth, Ohio (not signed)	13	2,015 00	5	370 00	2,385 00
8	O. A. & W. T. Thayer, Charleston, Kanawha County, W. Va	8.5	1,317 50	5	370 00	1,687 50

* Contract with the Snead and Company Iron Works.

REPORT OF MR. A. M. SCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, W. Va., July 10, 1885.

COLONEL: I have the honor to submit the following report on the improvement of the Great Kanawha River for the year ending June 30, 1885.

LOCK NO. 2.—FOR STATIONARY DAM.

[Above Charleston 26½ miles; above the mouth of the river 84½ miles.]

The laying of masonry within the coffer-dam for the foundations of this lock was begun, as stated in the last annual report, on June 23, 1884.

The summer and fall of 1884 were favorable for the work, and the contractor, Mr. Frank Hefright, made good progress. But six working days were lost at setting masonry between July 12 and the suspension of operations for the winter, December 16. During the winter and spring but little was accomplished in the quarry or yard, owing to unusually bad weather. Active operations were resumed in April—stone-cutting on the 14th and setting on the 28th. The coffer-dam was flooded and masonry work suspended by a rise in the river on May 24. The pumps were started again June 5. The laying of masonry was resumed on the 8th, and there has been no interruption since that time.

The following is a summary of principal items of work done during the year under this contract for "building part of Lock No. 2:"

Mortared masonry of all classes	cubic yards	9,922
Excavation for foundations	do	9,180
Embankment and puddling	do	3,815
Timber in permanent construction	feet B. M.	80,000

The work embraced by this contract is nearly completed. The time for it expires September 15, and it is expected the work will be finished before that time. This will bring the masonry of the lock, including miter and cross-sills, breast-walls, filling and discharging culverts complete, up to the level of top of upper miter-sill, being about 18 feet above rock foundation, and within 20 feet of final top of coping. The land wall and upper wings will, under this contract, be carried two courses (3 feet 8 inches) above the upper miter-sill, and the embankment between the wall and bank and the guard-crib at the foot be brought up level with the masonry.

Contract for finishing Lock No. 2.—In compliance with your advertisement, proposals for the completion of the lock were opened February 3, 1885. The lowest bidder was C. H. Strong & Son, of Cleveland, to whom the work was awarded by contract dated February 27. Actual building under the contract must, in the main, wait for the completion of work under the first contract. Messrs. Strong & Son have, however, made arrangements to begin work in the quarry near the site, from which the greater part of the stone for the lock have been taken, putting down tramways, &c., with a view to going on with the masonry without loss of time as soon as Mr. Hefright is out of the way. They expect to begin this preliminary work within a few days.

Iron work for Lock No. 2.—Proposals for the iron filling-valves and attachments, gate anchorage, and boxes for the trestle-dam across the head of the lock were opened, in accordance with your advertisement, May 19, 1885. The work was awarded to the Snead & Company Iron Works, of Louisville, Ky., the lowest bidder, by contract dated June 8.

They are now at work on these irons, and are likely to complete the contract within the time allowed, August 20, 1885. Mr. T. Schoonmaker, civil engineer, has continued to act as inspector at No. 2. During the working season last year he was assisted by W. D. Isaacs, a practical mason and stonecutter, employed to look especially after the building of masonry. Mr. J. H. Minnick, so favorably known as inspector during the construction of Lock and Dam No. 5, has been employed in this capacity since the resumption of work this year.

Mr. Schoonmaker rendered valuable assistance in the Charleston office, where he was engaged during part of the winter on the drawings and designs of the iron work referred to for this lock.

LOCK NO. 3.—(PAINT CREEK) STATIONARY DAM.

[21 miles above Charleston.]

This lock has remained in good working order during the year.

The following is a summary from the records kept at the lock for the twelve months ending June 30, 1885:

Number of steamers locked	1,568
Coal barges	409
Other craft	70
Number of passengers	8,778
Number of feet of lumber, B. M	220,000
Number of bushels of coal	1,650,300
Total number of lockages made	1,657

Locking was suspended by ice nine and one-half days during the year, from February 19 to the 28th. The water has not been high enough to prevent locking since March 20, 1884.

There has been no material change in the banks below the work during the year, though the scour on the abutment side has increased to some extent. The riprap protection has been continued 234 feet further down the stream on that side. The greater part of the riprapping was done by the lock hands.

LOCK NO. 4.—MOVABLE DAM.

[16 miles above Charleston.]

This dam has been up 185 days during the year. It was down on the date of the last annual report, having been thrown June 26 for a rise.

It was put up July 12, and was not lowered again until December 22, remaining up continuously 162 days. In lowering, December 22, eighteen pass wickets failed to trip and were lowered from a boat. Time taken to get everything down, four hours.

The dam was not entirely raised again till May 16. It was let down again May 24 for a rise in the river. In lowering, the lock tripper worked well, but the pier bar had become displaced and off the guides, and the twenty-eight wickets on that side were all let down by hand. Notwithstanding this, the entire dam was safely lowered in three hours.

The water got down so that work at raising began June 12. The dam was not entirely closed till the evening of the 14th, the greater part of three days being spent in diving to get the tripping-bars in place.

Both were found off the guides and the one on the lock side considerably bent—buckled up—in one place.

The dam has remained up since the 14th. The year's experience has still further confirmed the advisability of putting in the stepped hurters on at least one full section of this pass. The present arrangement at Dam 5, where one of the tripping-bars has been entirely removed and the other shortened, is very satisfactory, and could be followed with decided advantage at No. 4.

The following is a summary of records kept at the lock for the year:

Number of steamers locked	1,016
Coal barges locked	456
Miscellaneous craft locked	18
Coal down through lock ..... bushels	1,682,000
Total lockages made	1,124
Number of steamers through navigation pass	1,205
Coal barges through pass	740
Miscellaneous craft through pass	21
Coal down through pass ..... bushels	3,538,000
Rainfall ..... inches	31.96

LOCK NO. 5.—MOVABLE DAM.

[Nine miles above Charleston.]

The dam has been up 193 days during the year. It was down at the date of the last annual report. It was entirely up again July 15, and with the exception of a partial lowering in September for repairs, it remained up until December 22. The lowering on the 22d was done in two hours and fifty minutes. The forty-six pass wickets, provided with the stepped hurters, were "tripped" in thirty-five minutes. Two of them failed to fall, however, for some reason, and had to be pulled down from a boat.

The dam was raised again December 29 and 30 (it took four men thirteen hours), and remained up till January 13, when it was thrown for a rise. The lowering began at 3 a. m. and was finished at 7 a. m. No difficulty experienced. Just one hour was taken to let down the wickets with stepped hurters on the pass.

The dam remained down, after the lowering January 13, till May 16. It took the regular force and one extra man—five in all—about two and one-half days to clear the pass foundations of the winter's deposit of mud, &c., and put up the dam. The works, as well as those at No. 4, were found in general good order, and to have sustained no noticeable injury during the winter. The dam remained up but eight days in May, being thrown at the same time as No. 4 for the rise on the 24th. It was entirely lowered in two hours and twenty minutes. It was closed again June 12 and 13, and has remained up since.

Repairs and improvements.—The twelve additional Pasquean hurters were put in on the pier section of pass in September. Forty-six of the pass wickets now have the new hurters, leaving the remaining sixteen to be operated by the shortened pier-bar.

On the weir the chain fastenings of the twenty-six Pasquean-arranged wickets have been strengthened to adapt them to the new maneuvers. No more of these hurters have been put in on the weir. The difficulties referred to in connection with them in the last report have not been overcome, and it is probable that no further changes in the hurters of the weirs will be found advisable. In fact, experience proves that the stepped hurters are ordinarily of no advantage on high weirs like Dams 4 and 5, and their use, as explained somewhat at length in a recent report, only exceptional.

At all three of the finished works a considerable amount of work has been done during the year in the way of repairs and improvements to the lock and dam appurtenances, buildings, fences, grounds, &c., by the regularly employed hands.

The following is from the records kept at Lock No. 5.

Number of steamers locked during year		1,514
Coal barges locked		825
Miscellaneous craft locked		38
Coal down through lock	bushels..	2,649,700
Total lockages made		1,580
Number of steamers through navigation pass		1,505
Coal barges through pass		1,271
Miscellaneous craft through pass		19
Coal through pass	bushels..	5,307,100
Rainfall	inches..	29.80

DAM NO. 6.—FOR MOVABLE DAM.

[Four miles below Charleston and 54 from the mouth of the river.]

In accordance with your advertisement, dated July 17, 1884, proposals for building the foundations or immovable parts of this dam, on the plan described in the last annual report, were opened August 27. The work was let to the lowest bidder, Harold & McDonald, by contract dated September 20, 1884.

The contractors began dredging for the first section of the Navigation-Pass coffer-dam September 26. This section, which incloses 150 feet of the pass next the lock, was so far advanced that the pumps were started November 7. Excavation inside began on the 9th, and the first concrete was placed on the 19th. The placing of masonry and concrete was continued without interruption until December 13, when the coffer was allowed to fill and all work in the river suspended for the winter. But little was accomplished during the winter in the quarry or yard. The force was increased as the weather got better, and at present the stone are nearly all cut and all of the concrete broken for the pass, and some progress made in cutting stone for the pier and weir.

The coffer-pumps were started again May 13, and the water was out so that excavation began on the 14th. About 800 cubic yards of material, mostly sand, had been deposited on the work within the coffer-dam by the winter and spring floods. This was all removed and the placing of concrete and timber had just commenced when the coffer was flooded by the rise of May 24. The water got down so the pumps were started again June 4. Work inside was resumed on the 5th, and has progressed without interruption since that date.

The following is a brief statement of the work done within this first section of pass coffer (inclosing 150 feet from the lock) to date.

The concrete, with the exception of a few yards, is all placed; the down-stream wall is finished and the dowels in coping are now going in; the up-stream wall is all ready for the coping or "upper sill," and 50 linear feet of the sill, out from the lock, is set; the anchor bolts are all in; of the longitudinal or box timbers twenty-two are down, paving between them about half set, and the horse and trestle boxes partly placed. Unless interfered with by a rise, work on this section of the pass, including the placing of all the irons ready for the wickets, will probably be completed in about three weeks.

Second section of coffer-dam.—The building of the section of coffer, which will inclose the remainder of the pass, the pier, and about 90 feet of the weir (leaving about 220 feet of weir to be built within the third and last section) is to be commenced at once. The dredges began excavating for the outer end of this second section to-day, July 10.

IRON WORK FOR DAM 6.

Foundation irons.—You invited proposals for the irons to be built into the foundations of this dam including wicket and bridge anchorage, horse and trestle-box bolts, sill irons, dowels, clamps, drift-bolts, &c., by advertisement dated October 30, 1884. The work was awarded to the lowest formal bidder, O. A. and W. T. Thayer, by contract dated December 19, who completed and delivered the last of the irons in March.

Iron work for Navigation Pass.—After regular advertisement, you contracted, by agreement dated February 20, 1885, with the Snead & Company Iron Works of Louisville, the lowest bidders, for the iron work for the movable parts of the pass.

They delivered the principal part of the cast iron, including the boxes, hurters, slides, &c., in May, and all of the horses and props and a lot of smaller wrought parts in June. They are now at work on the trestles, aprons, &c., of the service bridge, and will, it is thought, complete their contract before the expiration of their time, August 31, 1885.

Mr. C. E. Gardner, our former dredge-boat engineer, has been employed as inspector of this iron work, and at present also of the irons for Lock No. 2, at the contractor's works in Louisville since March last.

Mr. E. H. Kirlin has been employed as inspector at No. 6 since the beiginning of work on the dam in September.

Mr. T. E. Jeffries, assistant engineer, has been employed regularly during the year, mainly on duty in connection with Dam No. 6. During the winter and spring and whenever not engaged at the dam, he has rendered valuable service in this office, particularly on the plans and drawings of the iron work.

DREDGE AND TOW-BOAT.

This dredge, assisted by the tow-boat, resumed work in No. 5 Pool at Witcher's Creek Shoal July 24, and, with the exception of seventeen days spent in removing rock from Pool 4, as noted below, was kept steadily employed there until December 8, when both were laid up for winter.

The working time was distributed as follows:

	Days.
Dredging in No. 5 Pool	88
On rock in No. 4 Pool	17
Total	105

The depth at Witcher's was increased last season from something less than 5 feet to full 6 below pool level. The work extended over a large area, and took a good deal of time for the amount of material handled. We have now at that shoal (the highest point in the pool) 6 feet available water, with the dam up, through a channel from 120 to 160 feet wide.

The work in No. 4 pool consisted in finishing up the blasting and reduction or removal of several large rocks near Blacksburg. These rocks were near the middle of the river, and, though there was good water on both sides, have always been an annoyance, particularly to tow-boats. They were either removed or their tops reduced to full 6 feet below pool-level.

The dredge has been laid up thus far this season. The project contemplates only about one month of dredging this year, mostly at the lock approaches, to be done during low water, as opportunity offers.

REMOVING OBSTRUCTIONS WITH CRANE-BOAT, ETC.

Authority having been given to spend a small amount in removing obstructions, repairing chute-walls, &c., a party of twelve men, under Capt. William A. Wright, tow-boat pilot, were employed from September 24 to October 13, inclusive, in crane-boat work between Charleston and the mouth of the river. Fifty-two logs and snags, four hundred and nine stones, and two sunken coal-barges were removed from or near the channel. In addition, within the time mentioned, six and one-half days were taken up by the party in repairing walls and reducing bars in the towing channels at Red House Knob and Thirteen-Mile Shoals.

At Lykens (Cannelton) Shoal a party of seventeen men were employed two days in October in widening and straightening the towing-channel. The bar at the head was cut down about 2 feet, five large rock were blasted and removed and three buoys set in the dug chute wall.

A force of from nine to eleven men spent sixteen days, altogether, in reducing bars in the towing-channels at Elk Island and Tyler shoals. At Elk the bar was cut down about 8 inches and widened about 25 feet; at island the bar was lowered about 12 inches and widened 75 feet, at Tyler the bars at the head were lowered from 12 to 17 inches.

The work of removing obstructions, lowering bars, &c., done in low water at small expense, is of material benefit to tow-boat navigation and highly appreciated by tow-boat men. It reduces the danger of sinking or injuring barges and tends to the shipment of coal on lower stages.

COAL STATISTICS.

The Kanawha coal operators have been asked to furnish information in reference to coal mined and shipped during the year corresponding to former annual reports.

The statement will be forwarded to you as soon as complete.

Very respectfully, your obedient servant,

A. M. SCOTT,
Assistant Engineer.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers.

[Addenda.]

LETTER OF MR. A. M. SCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, W. Va., October 10, 1885.

COLONEL: I have the honor to submit herewith the detailed statement of coal shipped from mines on the Great Kanawha, below the falls, for the year ending June 1, 1885, and summaries of same for former years from previous reports.

It appears that the rapid increase in the coal business, shown by former reports, has not kept up, but that the production during the last year has barely "held its own" with that of 1884. The want of increase in shipments by river is directly due to the unprecedented low stages of water during the year. During the twelve months ending September 30, 1885, there has been but eighty-three days when the Charleston gauge stood at or about 6 feet. In other words, there has been but eighty-three days when there was water enough in the river below Charleston to ship coal. This is a good deal below the average. Our record for thirteen years shows an average of one hundred and forty-three days per year with Charleston gauge reading at and above 6 feet.

In this connection a comparison with our gauge record kept at Point Pleasant, the mouth of the river, during the last year is valuable. This gauge is set to show the available water in the Ohio below. From the record it appears there has been two hundred and twenty-two days during the year ending September 30 when there was 6 feet and upward of water for navigation in the Ohio below the Great Kanawha.

Coal-boat navigation on the Ohio from Point Pleasant down was suspended by ice forty-two days during the year. The Kanawha was obstructed by ice about ten days. After making allowance for suspension by ice, it appears that if the Great Kanawha had been slackwatered to its mouth Kanawha coal could have been shipped down the Ohio on one hundred and eighty days during the year instead of on but seventy-three days, a consideration of great importance, not only to Kanawha, but to the lower Ohio and Mississippi valley, so materially interested in a greater and more regular supply of coal.

There are, at present writing (October 10), fully 350 barges loaded with coal in the river, the greater part of which has been loaded from two to four months waiting a rise. There has not been shipping water in the Kanawha below the dams since June 6, while our Point Pleasant record shows the Ohio, from there down, to have been at and above 6 feet on fifty-nine days since that date.

Very respectfully, your obedient servant,

A. M. SCOTT.

Col. WM. P. CRAIGHILL,
Corps of Engineers.

Statement of coal shipped from mines on the Great Kanawha River, below Kanawha Falls, during the year ending June 1, 1885.

No.	Operators.	Shipments for year ending June 1, 1885.		
		By rail.	By river.	Total.
		Bushels.	*Bushels.*	*Bushels.*
1	Bennington Colliery		206,094	206,094
2	Black Band Iron and Coal Company	308,363	572,535	880,898
3	Campbell Creek Coal Company		3,175,814	3,175,814
4	Cannelton Coal Company	1,299,720		1,299,720
5	Carver Bros.	932,876		932,876
6	Cedar Grove Mining Company		826,597	826,597
7	Cedar Grove Pure Coal Company		338,800	338,800
8	Coal Valley Coal Company	536,457		536,457
9	Crescent Coal Mines	1,181,600		1,181,600
10	Crown Hill Splint Coal Company	245,421	1,115,407	1,360,828
11	Dana Bros		1,290,068	1,290,068
12	Davis, M. T., & Co	866,320		866,320
13	Eagle Coal and Coke Works	1,045,395		1,045,395
14	East Bank*			
15	Edith Marion Mines	548,324		548,324
16	Faulkner's Mines	1,003,240	56,000	1,059,240
17	Kanawha Cannel Coal Company		345,040	345,040
18	Kanawha Mining Company	554,967	909,838	1,464,805
19	Lovell Coal Company*			
20	McFarlane Coal Company*			
21	Marmet Mining Company		1,476,030	1,476,030
22	Mount Morris Coal Company	772,296		772,296
23	Peabody Coal Company		465,907	465,907
24	Peerless Coal Company		400,000	400,000
25	Pioneer Coal Company		1,419,470	1,419,470
26	Reynolds & Sturdevant	33,919	90,120	124,039
27	Robinson Coal Company	1,050,158	832,211	1,882,369
28	Straughan Coal Company*			
29	The Great Kanawha Colliery Company	202,328	122,360	324,688
30	The Saint Clair Company	575,000	120,000	695,000
31	The Union Coal Company	369,992	115,556	485,548
32	Winifrede Coal Company	500,000	2,065,476	2,565,476
	All others	945,841	1,869,000	2,814,841
	Total	12,972,217	17,812,323	30,784,540

* Included with "All others."

Summaries of former shipments from previous Annual Reports of the Chief of Engineers.

Shipped—	For year ending—		
	June 30, 1881.	June 1, 1883.	June 1, 1884.
	Bushels.	*Bushels.*	*Bushels.*
By rail	6,631,660	13,290,255	12,059,172
By river	9,628,696	15,370,458	18,421,084
Total	16,260,356	28,660,713	30,480,256

*Table showing the average number of days in each month the Great Kanawha River stood at and above different stages.**

Gauge-reading in even feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total days per year, being average for twelve years.
2	30.33	28.25	31.00	30.00	31.00	30.00	29.00	26.58	21.17	22.33	26.92	30.50	337.08
3	30.58	28.25	31.00	30.00	30.83	27.83	22.33	19.00	13.75	15.08	19.75	30.33	298.73
4	29.00	27.25	30.66	30.00	28.08	20.58	14.08	12.50	9.25	6.66	14.58	27.58	250.22
5	25.00	24.33	29.42	29.00	20.83	12.83	8.75	7.50	6.33	3.33	10.92	18.67	196.91
6	20.66	20.25	25.83	24.00	14.42	6.00	5.50	4.92	4.00	1.08	6.25	12.75	145.56
7	15.75	14.08	18.83	16.75	8.58	2.08	3.92	3.33	2.66	0.42	4.25	9.42	100.07
8	11.92	9.66	12.25	10.42	5.25	1.17	2.66	1.83	1.92	0.17	2.50	6.33	66.08
9	8.92	8.00	7.75	6.83	3.17	0.83	1.75	1.42	1.58	0.08	1.67	4.42	46.42
10	6.75	6.83	6.08	4.83	2.25	0.50	1.33	1.17	1.25	......	1.25	3.25	35.49
11	5.83	5.75	4.25	3.75	1.83	0.50	1.08	0.83	1.17	......	1.00	2.08	28.07
12	4.92	4.75	3.00	3.17	1.17	0.33	1.00	0.83	0.83	......	0.83	1.66	22.49
13	4.25	4.42	2.42	2.25	0.75	0.33	0.75	0.66	0.83	......	0.75	1.25	18.66
14	3.17	3.83	1.92	2.00	0.58	0.17	0.75	0.50	0.83	......	0.50	1.08	15.33
15	2.33	3.58	1.75	1.75	0.50	0.08	0.58	0.50	0.83	......	0.33	0.66	12.89
16	2.25	3.17	1.66	1.66	0.25	......	0.42	0.42	0.66	......	0.33	0.58	11.40
17	1.92	2.75	1.25	1.42	0.25	......	0.33	0.33	0.50	......	0.25	0.42	9.42
18	1.85	2.33	0.92	1.25	0.17	......	0.25	0.33	0.50	......	0.25	0.33	8.18
19	1.50	2.08	0.75	1.00	......	......	0.25	0.25	0.42	......	0.25	0.33	6.83
20	1.00	1.92	0.75	0.83	......	......	0.25	0.17	0.33	......	0.25	0.17	5.67
21	0.83	1.50	0.58	0.66	......	......	0.17	0.17	0.25	......	0.25	0.17	4.58
22	0.75	1.08	0.33	0.66	......	......	0.17	0.17	0.25	......	0.17	0.17	3.75
23	0.58	1.08	0.33	0.58	......	......	0.08	0.17	0.17	......	0.17	0.17	3.33
24	0.58	0.92	0.08	0.42	......	......	0.08	0.17	0.17	......	0.17	0.17	2.76
25	0.42	0.75	0.08	0.42	......	......	......	0.17	0.17	......	0.17	0.08	2.26
26	0.42	0.66	0.08	0.25	......	......	......	0.17	0.17	......	0.17	0.08	2.00
27	0.42	0.50	......	0.25	......	......	......	0.17	0.17	......	0.08	......	1.59
28	0.33	0.33	......	0.17	......	......	......	0.17	0.17	......	0.08	......	1.25
29	0.33	0.25	......	0.17	......	......	......	0.17	0.17	......	0.08	......	1.17
30	0.33	0.17	......	0.08	......	......	......	0.17	0.17	......	0.08	......	1.00
31	0.33	0.17	......	0.08	......	......	......	0.08	0.08	......	0.08	......	0.82
32	0.33	0.08	......	......	......	......	......	0.08	0.08	......	0.08	......	0.65
33	0.33	0.08	......	......	......	......	......	0.08	0.08	......	0.08	......	0.65
34	0.25	0.08	......	......	......	......	......	......	0.08	......	0.08	......	0.49
35	0.25	0.08	......	......	......	......	......	......	0.08	......	0.08	......	0.49
36	0.17	0.08	......	......	......	......	......	......	0.08	......	......	......	0.33
37	......	......	......	......	......	......	......	......	0.08	......	......	......	0.08
38	......	......	......	......	......	......	......	......	0.08	......	......	......	0.08
39	......	......	......	......	......	......	......	......	0.08	......	......	......	0.08
40	......	......	......	......	......	......	......	......	0.08	......	......	......	0.08
41	......	......	......	......	......	......	......	......	0.08	......	......	......	0.08

* The average being for twelve years beginning July 1, 1873, from records of the Charleston gauge kept at the United States engineer office at Charleston, W. Va. Gauge-reading the available water for navigation in the Great Kanawha below Charleston.

UNITED STATES ENGINEER OFFICE,
Charleston, W. Va., October 17, 1885.

D D 2.

IMPROVEMENT OF ELK RIVER, WEST VIRGINIA.

Some work, to the extent allowed by the small available balance, was done in August, September, and October, 1884. For details, reference is requested to the report below of Mr. A. M. Scott.

Some obstructions to the navigation yet remain, which are due to the action of certain individuals or corporations. They should be removed if further improvement is to be made by the United States.

Money statement.

July 1, 1884, amount available	$1,179 23
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,179 23
Amount that can be profitably expended in fiscal year ending June 30, 1887	3,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. A. M. SCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, W. Va., May 13, 1885.

COLONEL: I have the honor to submit the following report of operations at improving Elk River during the year.

The work done consisted in blasting and removing some large rocks from a troublesome bend known as the "End of the World," in Clay County, in repairing the old break in the Blue Creek Dam, and in removing obstructions and improving the channel for boats between Big Sandy and the mouth of the river.

BLASTING.

Work at the End of the World was commenced August 14, 1884, with a hired force of about eighteen men under the former overseer, Mr. H. H. Beall. It was finished August 27. Fifty rocks, some of them very large, containing altogether about 430 cubic yards, were blasted and taken out of the way.

These rocks have been the cause of numerous accidents both to flat-boats and rafts, and their removal is regarded by the rivermen as a decided improvement.

REPAIR OF DAM, ETC.

The repair of the break in the old timber and stone dam at the mouth of Blue Creek and the removal of obstructions mostly between that point and the mouth of the river were done during September and October, 1884, by a hired force under Mr. Ralph King, an Elk lumberman and pilot and a former foreman on the Elk improvement. About 160 feet of the dam, which is from 5 to 6 feet high, were entirely gone. The repair was made with long, heavy logs and short cross-sticks drift-bolted and pinned together and filled with stone. A brush and stone apron was also made below the new work, and considerable done to repair and strengthen the old part of the dam. Altogether about 1,700 linear feet of timber and 375 cubic yards of stone were used. Work on the dam was commenced September 10, and finished September 23. From that time till October 25, when all work was stopped by want of funds, a small force was employed in removing snags, large stones, sunken trees, &c., and in the reduction of gravel and bowlder-bars, mostly within a distance of 4 miles of the mouth of the river. This last work was mainly in the interest of barge and small-steamboat navigation. It was found that the Government funds would not be sufficient to remove all of the really serious obstructions in this part of the river, and parties interested raised about $100 to supplement the Government work.

This was spent under the direction of our foreman mostly in scraping and cutting down a bowlder bar just above the Elk Boom.

A material improvement was effected by this work in the lower part of the river, and several parties interested in staves, railroad ties, tan-bark, &c., the most of which comes out in barges and boats, have since expressed themselves highly pleased with it.

INDICTMENTS.

In reference to the indictments, referred to in former reports, against the owners of the old lock and dam, and also against the Elk River Boom Company, for obstructing navigation, as to the former, "personal service" has never been obtained, and no further action taken. The suit against the Elk River Boom Company was tried before the circuit court here in June last, but the jury failed to agree. It has been postponed twice since, but will, I am informed by the prosecuting attorney, come up for trial again next month.

Very respectfully, your obedient servant,

A. M. SCOTT,
Assistant Engineer.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers.

LETTER OF MR. A. M. SCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, W. Va., June 29, 1885.

COLONEL: In reply to yours of the 24th, I have to state that nothing further has been done in the suit against the Elk River Boom Company, and the prosecuting attorney just this morning informs me that the case has been postponed to the December term.

Very respectfully, your obedient servant,

A. M. SCOTT,
Assistant Engineer.

Col. WM. P. CRAIGHILL,
Corps of Engineers.

D D 3.

IMPROVEMENT OF NEW RIVER FROM THE MOUTH OF WILSON, IN GRAYSON COUNTY, VIRGINIA, TO THE MOUTH OF THE GREENBRIER RIVER, IN WEST VIRGINIA.

Nothing done on this river during the year ending June 30, 1885.

Money statement.

July 1, 1884, amount available	$3,079 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	79 08
July 1, 1885, amount available	3,000 00
Amount (estimated) required for completion of existing project	169,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	25,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

D D 4.

MODELS AND PLANS FOR MOVABLE DAMS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 5, 1885.

SIR: I have the honor to submit herewith a copy of the report of the Board of Engineer Officers, constituted by your authority to comply with the resolution of the House Committee on Rivers and Harbors, received at the War Department on 14th February last, requesting an examination to be made at Pittsburgh, Pa., of models, plans, &c., for movable dams and other improvements, with a report to the committee of the facts concerning the same and their opinions as to the utility thereof.

The Board, after giving notice by advertisement in newspapers of Pittsburgh, examined, with explanations from the inventors in person, the various inventions submitted to them, and in this report gives its views on the merits of each.

The majority of the inventions are modifications of the well-known bear-trap, designed to adapt this gate to wide chutes and to locks, and the Board reports that, as the United States is now preparing to build two wide bear-trap gates on the Kentucky River, and as the most promising of the many inventions examined will naturally be adopted for that work, it does not deem it necessary at this present time to make any special recommendations as to testing any of these devices.

The originals of the papers and drawings enumerated in the report of the Board are retained in this office, subject to the call of the committee, if required.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

LETTER OF THE CHAIRMAN OF THE COMMITTEE ON RIVERS AND HARBORS OF THE HOUSE OF REPRESENTATIVES.

HOUSE OF REPRESENTATIVES,
Washington, D. C., February 13, 1884.

SIR: I am instructed by the House Committee on Rivers and Harbors to transmit to you the inclosed resolution of the committee and to ask a compliance with their request.

Respectfully, yours,

ALBERT S. WILLIS,
Chairman.

Hon. ROBERT T. LINCOLN,
Secretary of War.

RESOLUTION OF THE HOUSE COMMITTEE ON RIVERS AND HARBORS.

Resolved, That the Secretary of War be requested to direct the Engineer Department to cause to be examined the models, plans for movable dams, and other river improvements at Pittsburgh, Pa., and report to this committee the facts concerning the same, and their opinion as to the utility thereof.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 19, 1884.

SIR: I have the honor to acknowledge the reference to this office on the 15th instant of the letter from the Hon. Albert S. Willis, chairman of the Committee on Rivers and Harbors of the House of Representatives, inclosing resolution of the committee relative to the examination of "models, plans for movable dams, and other river improvements at Pittsburgh, Pa.," &c., and to reply that a Board of Engineers for the consideration of questions pertaining to the proposed dam on the Kentucky River at Beattyville was constituted by your authority in October last. This Board, consisting of Lieut. Cols. W. P. Craighill and W. E. Merrill and Capt. James C. Post, of the Corps of Engineers, it is suggested, would be a proper one to perform the duty required by the Committee on Rivers and Harbors. I beg, therefore, to recommend that a Board to consist of the officers named be constituted to assemble at Pittsburgh, Pa., on the 15th of March, proximo, or as soon thereafter as the other duties of the members will permit, to examine and report upon the models, plans, &c., referred to in the resolution of the committee, and at the same time consider such other plans, &c., of like character as may be placed before it; and, with this view, that notice of its meeting be given through the medium of the Pittsburgh papers for the information of all concerned. With your sanction the order constituting the Board will be issued from this office.

The expenses of the Board, including mileage, may be paid from the appropriation for contingencies of rivers and harbors.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Brvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

[Indorsement.]

WAR DEPARTMENT,
February 23, 1884.

The within recommendations of the Chief of Engineers are approved.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

REPORT OF BOARD OF ENGINEERS.

JUNE 16, 1884.

GENERAL: The Board of Engineers, constituted by Special Orders No. 19, headquarters Corps of Engineers, United States Army, Washington, D. C., February 28, 1884, with directions "to assemble at Pittsburgh, Pa., to examine and report upon such models, plans, &c., for movable dams as may be placed before it," have the honor to submit the following report:

As soon as possible after the receipt of the order convening the Board advertisements were inserted in five newspapers of Pittsburgh, Pa., giving notice to inventors that the Board would assemble in that city on the 1st day of April, and inviting them to send in models of their inventions and to appear in person to explain them.

The Board met at Pittsburgh on the day appointed, and examined the models and heard the explanations of the inventors, in the hall of the Chamber of Commerce, which had been kindly placed at their disposal for this service. On account of the great number of models presented, and the imperfection of many of the drawings, the Board decided to request each inventor to send in complete drawings of his inventions, together with a written statement, embodying the substance of each invention, and the advantages claimed to arise from its use in practice.

These drawings and statements are attached to this report as appendices.

The inventions may be classified as follows:

Improved bear-trap gates for dams and locks.
Improved inlet valve.
Improved coffer-dams.
Improved fixed dam.

IMPROVED BEAR-TRAP GATE.

All of the inventions relate to minor additions or modifications of the well-known bear-trap gate, invented by Josiah White in 1818, of which there are many examples in the lumbering regions of Pennsylvania and Maryland. The essential features are the same in all.

Mr. John Du Bois, of Du Bois, Pa., has constructed a number of those now in use in Pennsylvania. They are of lifts varying from 4 feet to 18 feet, and are operated in chutes from 4 feet to 40 feet in width. In the narrower chutes the gates rise and fall uniformly, but in those of the extreme width mentioned there is a decided tendency for one end of the gates to move faster than the other. This may take place at either extremity, and is entirely independent of the point of entrance or exit of the water under the gates.

Two or three years ago Mr. Du Bois constructed a gate in a chute 120 feet wide in Dam No. 1, Monongahela River, in which this irregularity in movement was so great that it was found necessary to add to the under side of the lower leaf a movable stiffening truss. He submitted a model to the Board exhibiting this truss, which is also designed to prevent the lower leaf from rising too high. Relief openings are likewise provided between the two leaves, when at their greatest height, to guard against the overturning of the lower leaf from excess of under pressure, as has sometimes occurred. He has also added a relief weir to the culvert, conveying the water under the gate, in order to regulate this pressure. We believe that these modifications are useful improvements for long bear-trap gates.

Mr. G. W. Parsons, of Williamsport, Pa., presented models and drawings of bear-trap gates, which he has designed with a view to their use in a lock, instead of the usual miter gates. These gates are to be worked by double hydraulic presses, placed below the gate chambers, and actuated by the head of water; they are raised or lowered by forcing the piston in either direction. His plans have never been tried in practice.

The Board are of the opinion that this method of working bear-trap gates is liable to the serious objection that the hydraulic presses under the gates are inaccessible, and are much exposed to stoppages by sand and gravel clogging the working parts. In a subsequent design Mr. Parsons proposes to raise the operating cylinders to the level of the lower pool, placing them at the ends of the gates. This arrangement introduces new mechanical difficulties, which render their use in that position of doubtful practicability. The Board thinks that the probabilities of success for this system are small, and that even if it should in the end be successful, it offers no advantages over the simpler form of the ordinary bear-trap.

Mr. Parsons claims that a lock constructed according to his design, with numerous side culverts, needs but a single gate, which may be placed at either end, and that it can be used as an open chute without gates. By means of the side culverts he proposes to throw in so much additional water that the current due to a given head will be reduced to a velocity sufficiently low to permit boats to ascend the lock or chute, and overcome the assumed difference of level. In the discussion (Appendix B, he asserts that in a chute 1,000 feet long he can by these means so reduce the current due to a head of 10 feet as to obtain a velocity of only 1½ miles an hour.

The Board are of the opinion that these assertions cannot be sustained, and that the current through the lock or chute would be so great that no boat could ascend, nor could one descend in safety. According to the usual formulas for discharge, the resulting velocity would be about 18 miles per hour.

Mr. George Archibald, of Banksville, Pa., submitted a model of a bear-trap gate, whose chief difference from the usual type is in the manner in which water is let into and drawn out of the gate-chamber. His method is to drop the water down vertically through openings in the floor of the head bay, and then pass it under the sill of the upper leaf through small culverts. This is substantially the same as the method now in use on Locks 5, 6, and 7, of the Monongahela Navigation Company, with the exception that the valve shown in the model is not balanced. In this respect Mr. Archibald's valve is defective, as in its present shape it could not be handled by any power ordinarily available; but as it can readily be changed to a balanced valve without affecting the substance of the invention, it will be assumed that it is Mr. Archibald's intention to balance both entrance and exit valves.

The Board are of the opinion that, as a rule, it is preferable to have all valves in the abutments, where they are readily accessible in case of necessity. Mr. Archibald has arranged to limit the height to which the gate can rise by hooks and catches, that hold the leaves together when they have reached their maximum admissible height; he also uses sliding links, attached to the under side of the lower leaf. These devices are useful, but as something of this sort is common in all bear-trap gates, no special comment is necessary.

His model shows each leaf composed of several independent sections. No bear-trap, as far as known, has ever been built without having each leaf in a single piece, and the Board are of the opinion that continuous construction is essential in the present state of our knowledge and experience.

Mr. Arthur Kirk, of Pittsburgh, Pa., presented several models illustrating the modifications he proposes for use in the construction of bear-trap gates and their application to locks; also models for fixed dams and coffer-dams, together with a design for inlet-valves. In the construction of the foundations of fixed or movable dams and locks to which he applies the bear-trap gate instead of miter-gates, the essential feature is the substitution of merchantable boards for timber, as ordinarily used. A platform of boards is first laid, upon which tight walls of boards are built up to the proper height, and the pens thus formed are filled with broken stone, sand, or other ballast. He also uses boards in the construction of fixed dams, and of bear-trap gates.

In some localities it is possible that boards may be found to form an adequate and economical foundation, but their use in this connection is a matter that appeals so readily to the judgment of the constructing engineer that comment by the Board seems unnecessary. In building fixed dams boards cannot always be used with economy, as they tend to increase the labor of construction, and, after the dam is built, render it liable to more rapid deterioration, if not kept constantly submerged, by exposing a greater amount of surface to decay. It is a well-known fact that dams have already been constructed of boards or planks. In the application of bear-trap gates to locks, Mr. Kirk has two methods of raising the gates. They are either made buoyant, or else they are raised by the power furnished from a reservoir in the lock-walls, which is filled by pumps actuated by turbine-wheels. The usual type of bear-trap gate operates very well in a chute where there is a difference of level on the two sides of the gate, but when a pair of bear-trap gates is used, as in a lock, each gate must either be raised or lowered in still water. If the gates are made buoyant they will not sink, and if heavier than water they cannot be raised unless power can be brought to bear. It is possible to obviate these difficulties in this way:

Let the upper gate be made buoyant; it will then remain up and act as a gate in still water. If now the space underneath the gate be connected with the lower pool by a culvert, the pressure of the upper pool will keep the gate down, and thus the gate can be maneuvered under either condition. For the lower gate the conditions must be reversed. It must be made heavier than water, and can only be raised by bringing the head of the upper pool under it by means of culvert in the side walls. The necessity for these two large culverts would make this use of bear-traps usually more expensive than the ordinary miter-gates, and thus far they have not been used for locks.

Mr. Kirk has also several devices for limiting the height of the water under the gates and preventing them from being overturned by too great a pressure. These consist of relief weirs, automatic closing of the inlet and opening of the outlet valve, and a valve in the lower leaf which is opened when the gate passes beyond a certain limit. The Board consider that serious difficulties will be encountered in attempting to put in practice some of these methods, but they call attention to the use of relief weirs as likely to prove the most effective and practicable of those mentioned. The details of these various devices can be found in Mr. Kirk's plans, submitted herewith.

In the designs for coffer-dams Mr. Kirk has neglected a most essential feature required in such works—that of proper means of preventing leakage underneath his structure. To remedy this defect sheet-piling must be driven, or some method devised to prevent water from passing through the permeable strata upon which his pontons rest. When this is properly done the cost of using this design would be so great that the Board do not feel that they can recommend it as a substitute for the methods now in use, as it has not been made to appear that it has any special advantage beyond the fact that the pontons may be removed and used again in constructing other coffer-dams.

Mr. Kirk also called special attention to the hinge, which he had designed for fastening bear-trap gates, and also to his improved inlet-valve. As to the former, the Board think it sufficient to state that it appears to be a good hinge. It does not, however, possess marked advantages over several others that the Board have seen, and therefore they regard a simple mention of it sufficient.

The improved valve is shown on Sheet No. 19 of the drawings submitted by Mr. Kirk, and is fully described by him (see Appendix D). So far as is known to the Board, this valve has never been tried practically. The combination of sliding and rolling action, as shown in the model exhibited to the Board, seems to warrant the opinion that it is likely to prove a useful valve, notwithstanding its slow movement. It probably can be used to advantage where sluicing is necessary, such as in locks and chutes, but as a substitute for the ordinary valves of filling or emptying culverts for locks or movable dams, too much time is consumed in opening or closing this valve to make it available for such purposes.

In addition to examining the models which were submitted to them, the Board were directed by your indorsement of February 29, 1884, on a letter from T. H. Pollock, of Monongahela City, Pa., to consider the apparatus for opening and closing lock-gates for which Mr. Pollock has received letters patent No. 287575, dated October 30, 1883. Mr. Pollock's invention is substantially as follows:

On each lock-wall he runs a shaft, extending nearly the full length of the wall, which is put in motion by any convenient source of power. Parallel to this main shaft are a number of short counter-shafts, provided with drums, some of which receive the lines used for opening the gates and others the lines used for shutting the gates, which pull on the outer end of a spar, whose inner end is fastened to the gate. Motion is transmitted at will from the constantly moving shaft to any one of the counter-shafts through friction gearing, the particular style used in the case in question being toothed friction rollers, such as are common in iron mills. The counter-shafts have a slight play around one end, as a center, so that the rollers may be thrown in and out of gear by a lever

Besides operating the gates, the patent contemplates the use of one or more capstans, each similarly attached to an independent counter-shaft and similarly actuated. These capstans are for pulling boats into or out of the locks.

The patentee only claims the combination of the devices which have been just described, no claim being made for the devices themselves, all of which are well known to mechanics.

The Board saw the combination at work at Lock No. 1 on the Monongahela River, and consider it an excellent one for use under similar conditions. The plans for Government Lock No. 8, on the Monongahela River, which were prepared some years back, contemplate the use of somewhat similar mechanism, with the exception that local conditions made it advisable to have a separate source of power at each gate. The use of friction gearing is believed to be indispensable in such cases.

The service of locks is much expedited by the use of such devices, and the Board heartily commend them to the profession.

CONCLUSION.

The instructions received by the Board direct them to examine and report upon the various models submitted to them, and they have endeavored to comply with these instructions by permitting all inventors to speak for themselves, and by giving their own opinions on the various inventions submitted to them. Some of these inventions are meritorious, and by bringing them to the attention of engineers those to whose work they are adapted can make use of them.

The majority of the inventions that came before the Board are modifications of the venerable and well-known bear-trap, and they are chiefly designed to adapt this gate to wide chutes and to locks, its past service having been limited to narrow chutes. As the United States is now preparing to build two wide bear-trap gates on the Kentucky River, on the recommendation of the members of this Board, and as the most promising of the many modifications that have come before them will naturally be adopted for that work, it does not seem necessary at this present time to make any special recommendation as to testing any of these devices.

The following papers and drawings accompany this report:

**Appendix A.*—Statement of John Du Bois, describing his invention, with one sheet of tracings.

**Appendix B.*—Pamphlet and statement of G. W. Parsons, describing his inventions, with three sheets of drawings (blue prints).

**Appendix C.*—Letter of George Archibald, describing his inventions, with one sheet of drawings.

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*Appendixes not printed.

**Appendix D.*—Statement of Arthur Kirk, describing his inventions, accompanied by a book containing seventeen sheets of drawings.

**Appendix E.*—Letter of T. H. Pollock, with a description of his patent, referred to the Board by the Chief of Engineers.

Respectfully submitted.

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.
WM. E. MERRILL,
Lieut. Col. of Engineers.
JAS. C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

D D 5.

PRELIMINARY EXAMINATION OF GREENBRIER RIVER, WEST VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., November 4, 1884.

GENERAL: I have the honor to report that the required preliminary examination of the Greenbrier River, West Virginia, was made in the last third of October, 1884, by Mr. William Proctor Smith, lately of the Corps of Topographical Engineers, U. S. A., my other duties having prevented me from undertaking it in person.

A copy of Colonel Smith's report, dated November 1, 1884, is inclosed herewith.

The Greenbrier is about 125 miles long from the Forks near Traveler's Repose, in the northern part of Pocahontas County, West Virginia. Though it has a width of 600 or 800 feet at a few points, it is very shallow where so wide, its average width not exceeding or equaling 300 feet. The country through which it flows is believed to be well adapted for grazing, and moderately so for agriculture, containing fine timber and some valuable minerals. It is, however, very broken and hilly, and may even be styled mountainous. The declivity of the stream is considerable, averaging, Colonel Smith reports, about 8 feet to the mile.

From the mouth of Howard's Creek, near the Greenbrier White Sulphur Springs, in Greenbrier County, to Hinton, in Summers County, where it empties into the New River, the Greenbrier River was very carefully surveyed in 1874 by Lieut. Thomas Turtle, Corps of Engineers. His report was printed in full in the Report of the Chief of Engineers for 1877, Part I, commencing at page 709.

A portion of the river above the mouth of Howard's Creek for about 40 miles, as well as that covered by Captain Turtle's work, was surveyed some sixty years ago by Captain McNeil, of the United States Corps of Topographical Engineers, whose report is printed in the document referred to above, commencing on page 762.

The river is not navigable, and the portion of New River below its mouth is also unnavigable. A down-stream sluice navigation for batteaux might be made at a cost of about $125,000, the sluices to be 25 feet wide and 2 feet deep at low water. If the sluices were made 50 feet wide the cost would be doubled. Such a navigation would enable the products of agriculture and the mines to be transported more cheaply to the Chesapeake and Ohio Railroad than by hauling in wagons, as at present; but it would probably be still necessary for the people to depend almost entirely on land transportation for return freights. To give a convenient water transportation both up and down stream would require the construction of numerous locks and dams, at a total cost very much greater than that given above for sluice navigation.

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*Appendixes not printed.

For details of the commercial condition of the country through and near which the river flows, reference is requested to Colonel Smith's report.

Under all the circumstances of the case as given above and in Colonel Smith's report, I do not consider the advantages which would result from an improvement of the Greenbrier sufficient to justify the cost, and therefore I report, in the phraseology of the law, that in my opinion the Greenbrier is not "worthy of improvement by the General Government."

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. WILLIAM PROCTOR SMITH, ASSISTANT ENGINEER.

BALTIMORE, MD., *November* 1, 1884.

COLONEL: In compliance with your instructions to make an examination of Greenbrier River, West Virginia, I have the honor to report that I left Wilmington, Del., on the 17th of October, and proceeded by rail to Ronceverte, W. Va., a station on the Chesapeake and Ohio Railway, thence by wagon to the forks of the river, a distance by land of 89 miles, and returning by various roads which cross the stream, for none are found along the river banks. I got a very good idea of the country and river from its source to the mouth of Howard's Creek, a distance of about 100 miles, at which point I finished the examination, as a complete survey was made in 1874, from the creek mentioned to the mouth of the Greenbrier at New River, a distance of 49 miles, by Capt. Thomas Turtle, Corps of Engineers, a description of which may be found in your report to the Chief of Engineers for the year 1877 (Appendix V, on the third division of the central transportation route to the seaboard).

The Greenbrier River has its source in what is called the Back Alleghany Mountain, in the northern part of Pocahontas County, and is composed of two forks, east and west, which, uniting 20 or 25 miles below, form the main stream, 125 feet in width, which increases to 700 feet at Marlin's Bottom, or the mouth of Knapp's Creek, and is about the same at the mouth of Howard's Creek. It flows southwesterly between the Alleghany Mountain proper on the east and Cheat and various other mountains on the west; the limits of the part under consideration being entirely in Pocahontas and Greenbrier Counties.

The river presents characteristics peculiar to all streams having their sources in the elevated regions of the Alleghany Mountains. It forces its passage through and around the points of small mountains, which frequently confine it within narrow limits, such as are to be found at the mouth of Deer Creek and Drop Mountain. In such cases its banks are steep, precipitous, and rugged, but for the greater part of the distance the hills slope down gradully and often recede from the river, showing rich flat alluvial deposits. Its principal tributaries from the east, going downstream, are Deer, Setlington, Knapp's, Beaver, and Anthony's creeks, and Spice Run at Drop Mountain, and from the West Clover Lick, Stony, and Spring creeks, with some minor streams. During freshets the river rises about 5 feet at the forks, 8 feet at Marlin's Bottom, and 12 feet at Greenbrier Bridge, near the mouth of Howard's Creek. At the time of examination the water was very low, in fact lower than it has been for several years. At one point, Falling Springs, about 23 miles above Howard's Creek, the bed was entirely dry for 1½ miles, the water having sunk, which occurs only on rare occasions when it is excessively dry. The bed of the stream is composed of sandstone, over which the current flows smoothly and freely, except at one or two points.

mentioned above, where the river is narrowed by the approach of the mountains. There are no precipitous falls, such as are generally found in streams in mountainous districts, and very few ledges make their appearance. The average fall seems to be about 8 feet per mile, some places as much as 10 feet, and others as low as 5 feet. The river divides the limestone lands on the west from the sandstone lands on the east. The country on the west is hilly, but very productive; on the east the land is light and not very good for farming purposes, but it has on it the finest of white pine, and the Beaver Lick Mountains, between the Alleghany and the river, and extending from Dunmore to Howard's Creek, 65 miles, are full of red and brown hematite iron ores—the same veins that run through to Chattanooga, Tenn., and Birmingham, Ala. Near Dunmore magnetic iron ore is said to exist in Michael's Mountain. On the west side of the river, white oak, hickory, poplar, walnut, cherry, and yew pine are found in the greatest abundance. Blue-grass, timothy, clover, and red-top furnish plenty of grazing and hay. Lumber and cattle are now the principal sources of wealth, and iron will soon be added thereto. Coal has been found in Cheat Mountain, both above and below the forks, and also near Greenbrier Bridge, and iron in the latter locality, which belongs to the great belt already mentioned. The limestone is blue, and makes a good building material, as well as produces all the lime used in the country and some for shipment. The sandstone is the best of its kind.

There are ten towns in Pocahontas County, with a population from 25 to 100 persons each, the stores of which sell annually about $150,000 worth of general merchandise. Goods are hauled to the northern part of the county from Staunton, Va., a distance of 75 to 100 miles, over five mountain ranges, and the products of the country taken away in the same manner. Huntersville, the county seat of Pocahontas, gets its supplies from Millborough, on the Chesapeake and Ohio Railway, 40 miles distant, and the southern part of the county deals at Lewisburg and Ronceverte. The former, the county town of Greenbrier, 4 miles from the railway, containing a population of about 1,200, has 10 stores, selling $100,000 worth of goods per year, 2 carriage factories, and 2 furniture establishments; the latter, a flourishing town, from 800 to 1,000 inhabitants, on the Chesapeake and Ohio Railway, the station for all the up-county spoken of, has a large foundry and flour mill, eight or ten stores, which sell about as many goods as are sold in Lewisburg, and a steam saw-mill, with a capacity for sawing 100,000 feet per day, belonging to the Saint Lawrence Boom and Manufacturing Company, and has sawed this season all the logs floated down the Greenbrier and its tributaries this year, viz, 9,500,000 feet, into lumber and shingles. This company expects to get out the coming year 15,000,000 feet of white pine logs and saw them into lumber. It has a boom extending from Ronceverte nearly up to the mouth of Howard's Creek, about 4 miles. This boom enables the company to run or float its logs. With good rises in the river this company, which only cuts white pine, which floats easily, has had no trouble in the past three seasons; but should the river not rise, as was the case for several years before, it would have great difficulty in getting over the rocks, particularly at Droop Mountain. Some work is absolutely needed for those timber owners who have no boom and wish to raft their logs or timber, which requires more water than for running, particularly should the rafts be composed of white oak or some other heavy timber.

There are eleven small towns in Greenbrier County besides those referred to above tributary to the river, with 15 stores, which sell annually $150,000 worth of goods; these with the others mentioned give a total of $500,000 worth of general merchandise sold in this section of the country per annum.

The celebrated Greenbrier White Sulphur Springs are on Howard's Creek, 6 miles from the river, which yearly consume large quantities of the farm products of the counties referred to, all of which has to be hauled in wagons for a long distance.

The area of country drained by the Greenbrier River and its tributaries, within the limits specified, is about 1,200 square miles. The number of farms, upwards of 2,000, containing nearly 200,000 acres, are valued at nearly $6,500,000. Seventeen thousand beef cattle are raised annually, whose value, with the other live stock, amounts to $950,000. The value of farm productions, as near as could be ascertained, is $750,000. Annual production of corn 330,000 bushels, and wheat 100,000. Assessed value of property, about $6,000,000. Population, 20,000.

In view of the wealth of this section of the country in minerals, timber, and agricultural products, and the fact that there is no outlet, except by wagon, through long distances and over rough roads, it is respectfully recommended that a survey, which will cost $3,300, be made from the forks to the mouth of Howard's Creek, a distance of 10 or 15 miles, for the purpose of ascertaining the best method of improving this river and the cost of the same.

Respectfully submitted.

WM. PROCTOR SMITH,
Assistant Engineer.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers, U. S. A.

APPENDIX E E.

IMPROVEMENT OF KENTUCKY AND TRADEWATER RIVERS, KENTUCKY; BIG SANDY RIVER, KENTUCKY AND WEST VIRGINIA; AND OF GUYANDOTTE, LITTLE KANAWHA, AND BUCKHANNON RIVERS, WEST VIRGINIA.

REPORT OF CAPTAIN JAMES C. POST, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Kentucky River, Kentucky.
2. Operating and keeping in repair locks and dams on the Kentucky River, Kentucky.
3. Tradewater River, Kentucky.
4. Big Sandy River, West Virginia and Kentucky.
5. Guyandotte River, West Virginia.
6. Little Kanawha River, West Virginia.
7. Buckhannon River, West Virgina.

EXAMINATIONS AND SURVEYS.

8. Rough River, Kentucky.
9. Condition of Green and Barren rivers, Kentucky.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, July 30, 1885.

GENERAL: I transmit herewith the annual reports for the fiscal year ending June 30, 1885, for the several works of improvement under my charge.

Very respectfully, your obedient servant,

JAS. C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

E E 1.

IMPROVEMENT OF KENTUCKY RIVER, KENTUCKY.

Operations for the improvement of this river have been continued during the past fiscal year, and the following work has been accomplished:

LOCK AND DAM NO. 1.

The outlet to the breach has been raised and about 5,000 cubic yards of backing have been placed behind the dam, closing the leaks through it, and most of those through the abutment. This work has resulted in the accumulation of additional deposit in the breach. The greater part of the area included within it is at the present time higher than the crest of the dam, and a considerable portion is under cultivation. Below the lock a bar, composed of drift, which obstructed the low-water channel, was removed by dredging. A shore crib was also built at the lower end of the lock as an aid to boats entering it, and also to prevent as far as possible the reformation of the bar. The timber for the guard-cribs and the backing for the dam were obtained by contract. The keepers dwelling at this lock, built by the State of Kentucky a number of years ago, was partially submerged during the freshets of 1883 and 1884. This caused its foundation to settle and the building to become so dilapidated it was necessary to have a new house. A contract for the new building has been entered into with J. J. Cox, of Carrollton, Ky., and work has been commenced. The site selected for it is above the level of the highest water thus far known.

LOCK AND DAM NO. 4.

During the past season dam No. 4 commenced leaking so badly it was feared navigation would be stopped and the work at No. 5 seriously interfered with. An effort was made to check the leaks by the use of additional backing and replacing some of the sheeting that could be reached without drawing down the pool. The work was but partially successful. The pool was kept at a height sufficient for boats of medium draught and navigation continued, although it was impossible to fill it. This dam is the only one remaining of those built by the State of Kentucky about forty years ago. In 1883 it was in an unsafe condition and had been observed to yield slightly when under a heavy pressure. Its apron or down stream half, intended to receive the falling water, had been carried away some years before, and the front, as it was left, presented a broken and patched condition; it also leaked considerably. During the low-water season of that year a new apron was constructed and the dam made secure against destruction. With the small balance of the appropriation remaining on hand at the time no other work could be done, and the examination and repair of the up-stream portion, where the leaks existed, was not undertaken. Since then they have continued to increase. It is proposed to thoroughly repair this dam during the present season.

LOCK AND DAM NO. 5.

The late date at which the appropriation bill was passed last year made it impossible to execute contracts and accomplish a full season's work at this lock. The lock-chamber and up-stream approach were cleared, the miter-sills rebuilt, the walls and coping partially repaired, the guard-cribs partly reconstructed, the gates framed, and a new abutment was built by contract. Contracts were also made for the construction of the dam and supplying the lock and gate irons. Work was commenced upon both these contracts, but neither was completed at the close of the year. The gate timbers and the timber for the cribs were obtained by contract. The site selected for the new dam is about 100 feet below the old one. Several years ago the latter was destroyed by the river making a breach 150 feet wide behind the abutment. The débris of the old work remains, and might have been used for the foundation of the new dam had not the place selected possessed several advantages over the old locations. At the new site both the dam and abutment will be upon rock, and the bank on the abutment side is also rock. The only disadvantage that exists arises from the probability of its being somewhat more expensive to construct the dam where it is proposed, but when it is completed the structure will be stronger and less liable to leak, being wholly new, than if composed partly of new and partly of old work.

SNAG-BOAT KWASIND.

Authority having been granted for the temporary transfer of the snag-boat Kwasind from the Wabash River to the Kentucky River, the removal of snags was commenced and continued in the month of September and the first part of October. During this time many of the most dangerous ones were removed between the mouth of the river and as far above Lock No. 5 as the state of the water would permit the boat to operate. The largest one taken out was estimated to weigh 32 tons and the others 15 tons or under. In the latter part of October, at the request of Lieutenant-Colonel Merrill, Corps of Engineers, the snag-boat was transferred to the Ohio River for a few weeks. Upon her return she was laid up, the season being too far advanced to continue work. As early this spring as the weather and river were suitable she was again equipped and sent above Dam No. 5, to complete the removal of the obstructions in that portion of the river before the dam was constructed and the water raised. With one or two exceptions, where the snags were too heavy to be lifted and will require blasting, this work was completed from Lock No. 5 to Shaker's Ferry, a distance of 44 miles. Snags and stumps were removed, overhanging trees felled, and such trees as were likely to be washed from the banks and become snags were girdled.

The following is a summary of the work done:

Snags and stumps removed	169
Trees cut down	22
Trees girdled	1,032

The Kwasind is a small gunwaled, hulled snag-boat, 120 feet long, with 24 feet beam. She was built in 1879, and, as is frequently the case with boats of this class, in the six years since she was built her timbers have become badly decayed. As the navigation of this river requires the use of a snag-boat yearly, application was made for the transfer of the Kwasind to the Kentucky River by purchase, the price to be paid being $1,000, the present value of her machinery and equipment. Authority was also requested for building a new boat, using such portions of the Kwasind in her construction and equipment as were suitable. Both of these requests have been granted. For additional details of the work done upon the lower river, reference is made to report of D. L. Sublett, assistant engineer, forwarded herewith.

SURVEY OF THE UPPER RIVER.

A survey of the river from Oregon to Beattyville has been completed by R. S. Burnett, assistant engineer, and sufficient data obtained to locate all the dams required in the extension of slackwater to the Three Forks. According to this survey the length of the Kentucky River is 261 miles from its mouth to the Three Forks, and the fall 211.2 feet in the same distance, or at the rate of 9.7 inches to the mile. The first five locks and dams, as soon as No. 5 is completed, will have a combined lift of 71.9 feet, and give a depth of 6 feet for navigation a distance of 98 miles. This leaves a fall of about 140 feet to be overcome by the additional locks and dams. It is believed this can be accomplished by the construction of eleven dams if they are given a slightly increased height over that originally proposed.

LOCK AND DAM NO. 6.

Efforts have been made to obtain the site for this lock as authorized by act of July 5, 1884; but up to this time they have been unsuccessful, owing to the difficulty in obtaining a good title to the land needed.

DAM AT BEATTYVILLE.

The commencement of the dam at Beattyville has also been delayed because of the difficulties in obtaining the land required. It is believed that these have now been overcome, and nothing will prevent the beginning of this dam at an early date.

IMPROVEMENT OF THE UPPER RIVER.

The inhabitants of the upper Kentucky Valley are unprovided with means for bringing their produce to market, except they use the mountain roads and the river during freshets. The former are frequently impassable from snow and ice, and their use at any time is difficult. The period during which the river is available is greatly reduced by the obstructions it contains. To remedy this evil, during the delay in the extension of slackwater navigation, application was made for authority to expend $1,500 of the amount appropriated for the Kentucky River in improving the river channel from Beattyville to the Kentucky Central Railroad Bridge, a distance of 80 miles. This project was approved, and parties are now being organized for the work. It will consist of the removal of snags, trees, and rocks and the construction of wing-dams concentrating the water upon the bars. It is expected this improvement will give a channel at least 60 feet wide, with a minimum depth of 3 feet for nine months each year.

PROPOSED OPERATIONS FOR 1885–'86.

During the fiscal year it is expected to complete the lock-house at No. 1 and Dam No. 5, and the improvement of the channel of the upper river, and also commence the construction of the dam at Beattyville. The land for lock and Dam No. 6 will be acquired, and contracts made for the purchase of as much of the materials required in their construction as the balance of the funds on hand will permit.

The recommendation in my last annual report, that authority be granted by Congress to obtain the land needed for the new locks and dams, in extending the slackwater improvements in advance of the appropriations being made for their construction, is renewed. Much delay in the progress of the work would in this way be avoided. The lack of such authority has prevented the dam at Beattyville from being commenced for the past three years, and already delayed the beginning of Lock No. 6 one year. With the amount asked for it is proposed to continue the improvement by the construction of additional locks and dams.

Eight abstracts of proposals received for materials required are inclosed herewith. Commercial statistics of Beattyville and vicinity, upper Kentucky River, are also inclosed.

Money statement.

July 1, 1884, amount available	$74,452 06
Amount appropriated by act approved July 5, 1884	250,000 00
	324,452 06
July 1, 1885, amount expended during fiscal year exclusive of outstanding liabilities July 1, 1884	59,730 26
July 1, 1885, amount available	264,721 80
Amount (estimated) required for completion of existing project	2,221,639 26
Amount that can be profitably expended in fiscal year ending June 30, 1887	500,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received by Capt. James C. Post, Corps of Engineers, during the fiscal year ending June 30, 1885, for furnishing materials and constructing an abutment to Dam No. 5, Kentucky River.

Names of bidders.	Price per cubic yard for masonry and coping. (Approximate quantity, 708 cubic yards.)	Price per linear foot for cramp irons or bolts.	Price per cubic yard for excavation. (Approximate quantity, 250 cubic yards.)	Total for masonry.	Total for excavation.
		Cents.	*Cents.*		
Minus Williams	$6 75	30	36⅔	$4,779 00	$91 66
A. G. Brauner	8 45	1	....	5,982 60	....
Brauner & McDaniel	8 50	35	28⅓	6,018 00	70 83
John Kirk	*8 00 †10 00	37½	75	5,798 44	187 50
John Kirk	9 65	37½	75	6,832 20	187 50
Thomas F. Sharkey and J. E. Abraham	10 95	20	90	7,752 60	225 00
Thomas Crowe	15 00	....	....	10,620 00	....

* For 640.78 cubic yards. † For 67.22 cubic yards.

Bids were opened August 18, 1884. Contract awarded to Minus Williams, of Frankfort, Ky., and executed under date of August 19, 1884.

For furnishing timber for repairing guard-cribs, Dam No. 1, Kentucky River, Kentucky.

Names of bidders.	Per linear foot.				Amount.	Aggregate.
	120 pieces 12 feet long.	67 pins 16 feet long.	64 pieces 24 feet long.	42 pieces 32 feet long.		
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Linear feet.*	
T. J. Hardin	18½	18½	18½	18½	6,992	$1,293 52
H. C. Jones	16½	16½	16½	16½	6,992	1,153 68

Bids opened August 7, 1884. Contract was awarded to H. C. Jones, of Madison, Ind., and executed under date of August 15, 1884.

For furnishing material for repairing Dam No. 1 and filling guard-cribs, Kentucky River, Kentucky.

No.	Names of bidders.	Backing.				Stone.		Aggregate.
		4,000 cubic yards of gravel.		1,000 cubic yards of clay.		1,000 cubic yards riprap.		
		Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	
1	R. B. Dean	$0 99	$3,960	$0 55	$550	$0 99	$990	$5,500
2	Kirk & Abraham	82½	3,300	57½	575	92½	925	4,800
3	G. W. Anderson	1 25	5,000	60	600	1 25	1,250	6,850
4	James O. Snyder	94	3,760	94	940	94	940	5,640

Bids opened August 15, 1884. Contract awarded to Kirk & Abraham, of Frankfort, Ky., and executed under date of August 18, 1884.

For furnishing timber for Lock No. 5 and approaches, Kentucky River, Kentucky.

Names of bidders.	Price per linear foot for crib timbers, &c. (Aggregate quantity required, 32,151 linear feet.)	Total.
	Cents.	
Thomas J. Hardin	16	$5,144 16
Henry C. Jones	20	6,430 20

Bids opened September 9, 1884. Contract award to Thomas J. Hardin, of Monterey, Ky., and executed under date of September 15, 1884.

For furnishing timber (204 pieces oak timber, 15,767 feet, B.M.) for lock-gates at Lock No. 5, Kentucky River, Kentucky.

Names of bidders.	Price per 1,000 feet, B. M., delivered on wharf at Frankfort, Ky.	Price per 1,000 feet, B. M., delivered in river, Lock No. 5, Kentucky River.
W. L. Pence	$23 00	$27 50
T. J. Congleton & Bro	40 00	42 00

Bids opened September 15, 1884. Contract awarded to W. L. Pence, of Frankfort, Ky., and executed under date of September 20, 1884.

For furnishing materials and labor for constructing Dam No. 5, Kentucky River, Kentucky.

Names of bidders.	Above water. Timber, 46,524 linear feet.		Under water. Timber, 80,240 linear feet.		Sheeting, 352,588 feet, B. M.		Spikes, 96,000 pounds.	
	Price per linear foot.	Amount.	Price per linear foot.	Amount.	Price per 1,000 feet.	Amount.	Price per pound.	Amount.
	Cents.		*Cents.*				*Cents.*	
I. V. Hoag, jr	23	$10,700 52	23	$18,455 20	$25	$8,814 70	5	$4,800
William Kirk	25	11,631 00	20	16,048 00	20	7,051 76	3	2,880
B. C. Howell	30	13,957 20	30	24,072 00	24	8,462 11	4	3,840
Thomas J. Hardin	32½	15,120 30	27½	22,066 00	25	8,814 70	7	6,720
C. J. McDonald	49	22,796 76	43	34,503 20	30	10,577 64	4½	4,320

Names of bidders.	Anchorage rods, 8,350 pounds.		Gravel backing, 6,000 cubic yards.		Riprap stone, 19,000 cubic yards.		Aggregate.
	Price per pound.	Amount.	Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	
	Cents.						
I. V. Hoag, jr	10	$835 00	$0 65	$3,900	$1 00	$19,000	$66,505 42
William Kirk	5	417 50	1 00	6,000	1 25	23,750	67,778 26
B. C. Howell	6	501 00	40	2,400	1 05	19,950	78,182 31
Thomas J. Hardin	10	835 00	1 10	6,600	1 00	19,000	79,156 00
C. J. McDonald	15	1,252 50	50	3,000	1 04	23,560	100,010 10

Bids opened October 20, 1884. Contract was awarded to Israel V. Hoag, jr., of Pittsburgh, Pa., and executed under date of November 17, 1884.

For furnishing cast and wrought-iron work for gates of Lock No. 5.

No.	Names of bidders.	Cast iron. (Approximate quantity, 14,481 pounds.)		Wrought iron. (Approximate quantity, 32,793 pounds.)		Aggregate.
		Price per pound.	Amount.	Price per pound.	Amount.	
		Cents.		*Cents.*		
1	Lomas Forge and Bridge Works	5.95	$861 61	4.15	$1,360 90	$2,222 51
2	Nunning & Lubbering	5.488	796 71	4.453	1,460 27	2,256 98
3	Queen City Bridge and Steam Forging Company	6.25	905 06	4.98	1,633 09	2,538 15
4	Francis Fritch	6	868 86	7	2,295 51	3,164 37
5	Stanton & Denire	3.75	543 08	10	3,279 30	3,822 38

Bids were opened May 23, 1885. Contract awarded to the Lomas Forge and Bridge Works, of Cincinnati, Ohio, and executed under date of May 25, 1885.

For furnishing all materials and labor for constructing a keeper's dwelling at Lock No. 1.

No.	Names of bidders.	Amount.	Remarks.
1	John J. Cox	$2,325	
2	William L. Graham	2,375	
3	Samuel Heath	2,400	
4	Abraham F. Kepping	3,500	
5	Benjamin F. Snyder	4,976	
6	James Nixon	4,990	Only one copy of proposal received without guarantee.

Bids opened June 1, 1885. Contract awarded to John J. Cox, of Carrollton, Ky., and executed under date of June 13, 1885.

REPORT OF MR. D. L. SUBLETT, ASSISTANT ENGINEER.

FRANKFORT, KY., *July* 16, 1885.

SIR: I would respectfully submit herewith my report for the fiscal year ending June 30, 1885, on the "improvement of the Kentucky River," embracing that portion between its mouth and the located site at Lock No. 6, about 100 miles. The plan of operations for the year contemplated the necessary improvements at Lock No. 1, mentioned in my last annual report, the building of an entire new dam at No. 5 on a new site, the erection of a new stone abutment, building new gates, the removal of old guard-cribs and erection of new ones, and the removal of the entire wood-work of the lock, such as miter-sills, flooring, side culverts, &c., the removal of old gates, excavating some 25,000 cubic yards of material from the lock and approaches, recutting hollow quoins, repairing coping and broken stone in the face of the lock-wall, repairing the road leading to Lawrenceburg, digging a well, and much other work of a miscellaneous nature incident to the repair of the old works, and the locating of Lock No. 6. Owing to the lateness of the season when the appropriation became available, it was not possible to make contracts in time to safely begin the construction of the dam, and the contractors confined their operations to getting all the material ready to commence it this season. Soon after the close of the preceding fiscal year Dam No. 4 was found to be leaking badly, and the pool going down threatened to suspend navigation above Frankfort, and thereby greatly impede, if not stop, the work at No. 5, which was entirely dependent on the river for the needed supplies and materials. The upper slope of this dam is old work, and was built some forty-five years ago, and extends from the crown 42 feet up-stream on a slope of 4 to 1, making the top of the pile sheeting, where the leaks were supposed to exist, over 10 feet below the pool-water or the crown of the dam. Owing to the large amount of brush, stone, &c., that has been put in from year to year to maintain navigation, it was impossible to coffer-dam with any assurance of success, and even then at very great cost, and to draw off the pool would virtually suspend the season's work at No. 5. It was decided, therefore, to stop, if possible, these leaks by means of gravel backing, cedar brush, and stone. Although this accomplished the object of keeping up navigation during the season to Lock No. 5, it did not entirely stop the leaks.

The following is a summary of the work during the fiscal year:

Lock No. 1: The dam was raised by means of beveled sheeting, and leveled so as to give full 6 feet of water at the lowest stage at Lock No. 2. The breach work and dam were backed with gravel, clay, and stone. The breach-crib was raised 18 inches to cover settlement, and brush and gravel placed behind to stop return of leaks under the old stone abutment. The area behind the breach, embracing some 4 acres, has rapidly filled, and is now several feet above the crown of the dam, part of it being under cultivation. The extension of the abutment crib below the dam was repaired and widened, and the breach bank raised so as to hold the silt deposited. Wing-walls of rubble dimension stone, laid dry, were built at the upper and lower ends of the lock. The lower guard-cribs were raised 4 to 8 feet and filled with stone, guide-post and fenders were put on the cribs, and the lock-chamber and approaches were dredged. Six hundred and seventy-five cubic feet of logs and 1,130 cubic yards of mud and gravel were removed. The side culverts under the breast wall were cleaned of mud by a submarine diver, after having been closed many years. The bridge near the lock was also repaired, and the construction of a new lock-house has been commenced.

The following material was expended at this dam, the work being done partly by contract and part by hired labor:

11,784	linear feet white oak, 12 feet by 12 inches.
19,505	feet B. M. white-oak sheeting.
7,739	pounds spikes.
50	screw-bolts.
67½	cubic yards rubble-stone.
191	cords of brush.
1,202	cubic yards riprap stone.
1,050	cubic yards clay backing.
3,923	cubic yards gravel backing.

This lock and dam is now to all appearances in good condition, excepting some repairs needed to the tail-bay of the lock.

Lock No. 4: 2,416 cubic yards stone and gravel, 268¾ cords cedar brush, and 5,436 feet B. M. of white-oak sheeting were used in repairing leaks in this dam. All condemned Government property was collected and sold at public auction.

Lock No. 5: All the timber for the dam has been cut, and at this date three-fourths delivered. Two-thirds of the stone filling has been quarried and all the iron delivered, and the contractor has begun dredging for the foundation. The contractor has completed the stone abutment, and the lock-gates are framed and are now being ironed. The hollow quoins have been recut and new pintles reset, and the entire wood-work of the lock rebuilt. The old guard-cribs have been excavated 3 feet to 8 below pool-water, and new ones built and filled with stone. Gauges have been cut on the lock-walls. The damaged coping and broken stone in the face of the walls have been removed, a quarry opened, and the necessary coping partially quarried and dressed. Some 12,000 cubic yards of material have been excavated from the lock and approaches by means of a dredge and crane-boat. A well has been dug, and the road leading to Lawrenceburg repaired. Owing to a crevice in the rock, which passed under the lower miter-sill, the bottom of the gate-chamber was blasted out 18 inches, and the floor timbered, concreted, and sheeted. With the exception of the dam, completing and hanging the gates, and dredging, the work at this lock is nearly completed, and, with a favorable season, it is believed it will be finished this year. The work has been under the local charge of Mr. M. W. Venable, assistant engineer, with Mr. J. W. Walker as inspector.

Lock No. 6: An examination by your direction of the located site of this lock at Oregon Ripple demonstrated that a change was necessary, and a new location was made about one mile below, greatly reducing the estimated cost of lock and dam and abutment, and securing a better site in every way.

The lands necessary for the works were surveyed, and borings for determining the nature of the foundations were made. The snag-boat Kwasind has been operating above No. 5 during the year, removing snags, and cutting and deadening overhanging trees. The year has been very favorable for the work. About 120 cubic yards of dimension stone belonging to the Government, quarried originally for the stone abutment at Lock No. 1, was brought from Madison, Ind., and used at Locks Nos. 1 and 5.

Before Pool No. 5 is raised, some very large bowlders, lying directly in the channel at Clear Creek Ripple, should be blasted and removed. A survey of Benson Bar, 7 miles above Frankfort, was made, and estimates for dredging about 1,000 yards of gravel made, to given the necessary depth of channel.

Very respectfully, your obedient servant,

D. L. Sublett,
Assistant Engineer.

Capt. James C. Post,
Corps of Engineers, U. S. A.

Commercial statistics of Beattyville and vicinity for fiscal year 1884–'85.

Articles.	Quantity.	Average price.	Value.
Coal .... bushels..	160,000	10 cents per bushel..	$16,000
Corn .... do..	5,440	75 cents per bushel..	4,080
Cross-ties .... number..	14,400	40 cents each.	5,760
Saw-logs .... do ..	123,130	$3 each	369,390
Staves .... do ..	600,000	$40 per thousand ...	24,000
Wheat .... bushels .	1,560	$1 per bushel	1,560
Merchandise	....	....	60,000
Passengers for four months	....	....	1,500
Total	....	....	482,290

E E 2.

OPERATING AND KEEPING IN REPAIR THE FOUR LOCKS AND DAMS ON THE KENTUCKY RIVER, KENTUCKY.

During the past fiscal year the navigation of the portion of the Kentucky River, 87 miles in length, improved by locks and dams was continuous, except for thirteen days, when the river was obstructed by ice.

The following repairs were made to the locks and dams during the year:

Lock No. 1: Walls repaired, pointed, and lower gates repaired.

Lock No. 2: Walls repaired and pointed, lock-chamber and approaches dredged, and upper shore crib repaired.

Lock No. 3: Walls pointed, 75 feet of lower guard-crib removed, and lower slope wall temporarily repaired. A short crib-jetty was constructed on abutment side to stop the cutting of banks by reaction; the crib portion of abutment was raised 8 feet, and extended up stream 32 feet to stop leak, and the lock and approaches were dredged.

Lock No. 4: Walls pointed, lower gates repaired, and lock and approaches were dredged.

For further details reference is made to the inclosed report of Assistant Engineer D. L. Sublett, superintending the navigation on the Kentucky River, who is entitled to much credit for its successful management.

During the past year the snag-boat Kwasind has been engaged removing obstructions to navigation from this portion of the river. The following is a summary of the work done:

Snags removed	151
Trees felled (leaning)	26
Insecure trees on banks girdled	574

The snag-boat also assisted in replacing stone on walls of Locks Nos. 1 and 2, and in repairing lower slope wall at No. 3.

The only accident of a serious nature that occurred upon this river during the year was the sinking of the freight and passenger steamer Hornet at Lock No. 1. The steamer was entering the lock from below during the prevalence of a heavy wind that came in violent gusts at a time when the river was high and the reaction from the dam very strong. The sudden impact of the wind, aided by the reaction, drove her against the top of the cribbing with great force, crushing in her hull. She sank in about fifteen minutes in 25 feet of water, after drifting a quarter of a mile. Owing to the prompt and efficient aid rendered by the lock-keepers no lives were lost. The steamer has since been raised, and is again running regularly.

A detailed statement of the expenses incurred during the past fiscal year is annexed to this report.

Attention is invited to the accompanying statistics of the commerce upon the river. Notwithstanding these are incomplete, as it has been found impossible to obtain copies of all of the manifests of the steamers, they amount to about $5,400,000 for the year, and show an increase of nearly 10 per cent. in the amount of commerce since my last annual report.

I desire to call attention also to that portion of Mr. Sublett's report, in which he refers to the saving of freight charges in this vicinity resulting from the improvements on the river. He estimates this at $73,000 during the past year. This amount will undoubtedly be greatly increased as soon as Dam No. 5 is completed.

For the fiscal year ending June 30, 1886, the estimate of the amount necessary to maintain navigation upon the river is $25,615. Annexed is a detailed statement. In addition to usual expenses of operating the locks, it is proposed to do the following work: Repair the plank and timber floor of the tail bay of Lock No. 1, and raise the entrance to the breach below the dam to cause further accumulation of deposit. The upper guard-crib at No. 2, built while the locks and dams were in charge of the State of Kentucky, will be repaired, and some minor repairs made to the gates. At No. 3 it is proposed to construct two short spur jetties, to protect the bank below the abutment from the reaction of the water, and the lower slope wall which has been undermined will be rebuilt.

The up-stream half of Dam No. 4 will be thoroughly examined, and such repairs made as may be found necessary when the sheeting has been removed. An estimate for this work was submitted to the Department in my letter of April 22. When a submerged structure of this character requires repairing its true condition cannot be ascertained except by lowering the pool, and removing the backing and sheeting, which would stop navigation. In view of this difficulty, and the necessity of obtaining authority in advance of doing the work, it was considered best to submit an estimate, based upon such information as could be obtained without interfering with navigation. This data was necessarily imperfect, and it is not improbable that the expenditures will exceed the amount estimated before the dam can be put in proper condition. A contract for the timber required for this dam, according to the estimate, has been made with Thomas J. Hardin, of Monterey, Ky.

An abstract of proposal, received for the materials required accompanies this report. An estimate for the year 1886–'87 is also annexed.

Besides the expenses for salaries, snagging, dredging, and contingencies, this includes $1,000 for continuing work upon the breach at No. 1. It is expected with proper care to cause the deposit of silt to continue in this area, until its height is greater than that of the normal level of the pool above the dam. When it reaches this elevation, and all the leaks are stopped, the dam will be regarded as entirely secure. This result might be effected at once, but the expenditure would be much greater than if only sufficient work is done from time to time to hold the accumulation of the material placed there during freshets.

Detailed statement of expenses incurred in preserving and maintaining navigation on that portion of the Kentucky River improved by locks and dams during fiscal year 1884–'85.

Date.	Lock No. 1.				Lock No. 2.			
	Salaries.	Current and contingent expenses.	Repairs.	Total.	Salaries.	Current and contingent expenses.	Repairs.	Total.
1884.								
July	......	......	......	......	......	......	......	......
August	$96 01	$7 21	......	$103 22	$118 43	$2 20	......	$120 63
September	118 43	......	$1 50	119 93	118 43	......	$1 50	119 93
October	118 43	4 70	195 83	318 96	118 43	*148 30	......	266 73
November	118 43	9 55	......	127 98	118 43	9 55	......	127 98
December	118 43	29 14	108 93	256 50	118 43	22 50	19 60	160 53
1885.								
January	118 43	7 85	141 00	267 28	118 43	7 75	4 50	130 68
February	118 43	18 75	6 25	143 43	118 43	5 94	......	124 37
March	118 43	4 86	......	123 29	118 43	4 86	......	123 29
April	118 43	7 20	......	125 63	118 43	7 20	9 46	135 09
May	118 43	21 61	......	140 04	118 43	22 15	28 64	169 22
June	118 43	......	......	118 43	118 43	......	52 55	170 98
Total	1,280 31	110 87	453 51	1,844 69	1,302 73	230 45	116 25	1,649 43

Detailed statement of expenses incurred in preserving and maintaining navigation on that portion of the Kentucky River improved by locks and dams, &c.—Continued.

Date.	Lock No. 3.				Lock No. 4.			
	Salaries.	Current and contingent expenses.	Repairs.	Total.	Salaries.	Current and contingent expenses.	Repairs.	Total.
1884.								
July	....	....	....	....	....	....	....	....
August	$118 43	$1 15	$1 50	$121 08	$118 43	....	....	$118 43
September	118 43	....	....	118 43	118 43	....	$15 05	133 48
October	118 43	*1,738 20	217 02	2,073 65	118 43	*$150 00	100 49	368 92
November	118 43	9 60	692 16	820 19	118 43	....	7 65	126 08
December	118 43	24 75	426 95	570 13	118 43	3 19	2 80	124 42
1885.								
January	118 43	14 00	474 88	607 31	118 43	23 25	3 00	144 68
February	118 43	9 08	....	127 51	118 43	10 18	3 00	131 61
March	118 43	4 86	....	123 29	118 43	4 86	....	123 29
April	118 43	7 25	96 71	222 39	118 43	17 44	85 88	221 75
May	118 43	26 83	....	145 26	118 43	99 60	5 59	223 62
June	118 43	....	174 62	293 05	118 43	....	....	118 43
Total	1,302 73	1,835 72	2,083 84	5,222 29	1,302 73	308 52	223 46	1,834 70

*For dredging, with the exception of $11.50 of amount charged to Lock No. 3, which was for transportation.

SUMMARY.

Total	$10,551 11
Removing snags	1,567 49
Total expenditure	12,118 60

Estimate of cost of maintaining navigation during fiscal year 1885–'86.

Locks.	Salaries.	Current and contingent expenses.	Repairs.	Total.
No. 1	$1,380	$500	$1,165	$3,045
No. 2	1,380	500	135	2,015
No. 3	1,380	500	3,150	5,030
No. 4	1,380	500	10,200	12,080
No. 5	1,095	350	....	1,445
				23,615
Removal of snags and dredging				2,000
Total				25,615

Estimate of cost of maintaining navigation during fiscal year 1886–'87.

Locks.	Salaries.	Current and contingent expenses.	Repairs.	Total.
No. 1	$1,380	$500	$1,000	$2,880
No. 2	1,380	500	....	1,880
No. 3	1,380	500	....	1,880
No. 4	1,380	500	....	1,880
No. 5	1,380	500	....	1,880
				10,400
Removal of snags and dredging				2,000
Total				12,400

For furnishing materials for repairing Dam No. 4.

No.	Names of bidders.	White-oak timber, 10,600 linear feet.		Spikes, 3,400 pounds.		Sheeting, 71,000 feet B. M.		Gravel backing, 1,500 cubic yards.				Aggregate.
								Kentucky River.		Ohio River.		
		Price per linear foot.	Amount.	Price per pound.	Amount.	Price per 1,000 feet, B. M.	Amount.	Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	
1	Thomas J. Hardin.	$0 16⅔	$1,766 67	......	......	......	......	......	......	......	......	$1,766 67
2	Gilbert W. Boyer & Co.	23	2,438 00	$0 07	$238	$18	$923	$0 95	$1,425	......	......	5,024 00
3	Gilbert W. Boyer & Co.	23	2,438 00	07	238	13	923	......	......	$1 30	1,950	5,549 00
4	James N. Abraham.	......	....	......	......	......	......	......	......	1 50	2,250	2,250 00

Bids opened May 5, 1885. Contract awarded to Thomas J. Hardin, Monterey, Ky., and contract executed under date of May 13, 1885.

REPORT OF MR. D. L. SUBLETT, ASSISTANT ENGINEER.

FRANKFORT, KY., *July* 15, 1885.

CAPTAIN: I respectfully submit herewith my report on the navigation of the Kentucky River for the fiscal year ending June 30, 1885.

This extends from the mouth to Tyrone, in Anderson County, a distance of 87 miles.

The unprecedented high water of the two preceding years has been followed by very low water during almost the entire year. The highest water at Dam No. 4 was 15.8 feet above the crown of the dam, or 22 feet above the upper miter sill. At Lock No. 1 backwater from the Ohio gave 43.50 feet above the lower sill, or 21 feet above the crown of the dam, which is 21 feet less than the highest water of 1884. The lowest water in the Ohio gave 4.41 feet on the lower miter sill.

Navigation has been steadily maintained for 352 days during the year. The remaining 13 days in January and February it was suspended on account of ice. For three days the larger boats were unable to pass the bridge at Worthville on account of backwater from the Ohio, and for 51 days these same boats could not pass the wooden bridge at Frankfort. No damage other than minor breakages has occurred.

During the months of May and June the United States snag-boat Kwasind, in charge of Captain James F. Browniske, cleared the pools of snags and overhanging trees, and deadened many others, greatly lessening the dangers of navigation. A dredge was also in operation during the low-water season of 1884, and removed 4,731 cubic yards of material from the chambers and approaches of Locks Nos. 2, 3, and 4. The only accident of note during the year was the sinking of the steamer Hornet, at Lock No. 1, which was caused by striking the submerged guard-crib while entering the lock from below, the water being high and the wind blowing a gale. She went down in 25 feet of water, but through the prompt efforts of the lock-tenders no lives were lost. The trade on the river has steadily increased notwithstanding business depression during the year, and there are now regularly navigating the river three passenger steamers and five tow-boats, with capacity varying from 150 to 450 tons.

There have been 754 more lockages during the past year than the preceding one, and if the number of craft that have passed Lock No. 5 be included, the increase would amount to 2,624, and the number given in my last annual report would be doubled. Freights have been reduced at Frankfort, as a result of the improvements, from 33⅓ and 25 cents per 100 pounds to 8 and 10 cents per 100 pounds. The retail price of coal has been reduced from 25 and 30 cents per bushel to 12 and 14 cents per bushel. During the year 512,000 bushels were transported up this river. This represents a saving to the people in this item alone of $66,000. Estimating the amount of miscellaneous merchandise transported at 17,000 tons, the saving in freights amounts to at least $73,000, not including the reduction on other freight. Tobacco is now carried from Frankfort to Louisville for $1 per hogshead, and the fare for each passenger for the same distance is also $1. The people tributary to the river seem to have been stimulated to new life by these conditions, as is evident by the generally-improved condition of the farms and farm-houses and the increased acreage under cultivation.

The following is a summary of repairs made during the fiscal year:

Lock No. 1.—The Government lands were inclosed by a wire fence, lock-walls were pointed, all snags were removed, and overhanging trees cut or belted, and three coping stones were cut and replaced in lock-wall. Operating irons were repaired, and screws substituted for bell-cranks on lower gates. The gauges were reset and the lower gate wicket repaired.

Lock No. 2.—Three hundred and forty-five yards of material was dredged from the lock and approaches, and placed above the dam. Three coping stones were replaced on lock-wall. Lock-walls were pointed and the upper shore crib repaired. Capstan was cut down and reset, and operating irons repaired. The premises were whitewashed and one wicket was repaired, and the pool was snagged and overhanging trees cut. A new keeper's dwelling is much needed at this lock.

Lock No. 3.—A jetty crib was erected in the abutment side below the dam, to protect the bank and break up a bad eddy. This has proved very beneficial, and it is believed the erection of two more will completely break up this eddy and cause the banks to rebuild which were washed away when the old dam broke. Some 75 feet of the lower river crib was removed and used in the jetty crib as this crib proved to be too long. The removal of this portion of the crib has greatly improved the approach and prevented the formation of a bar below the lock. The lower slope-wall having been originally built on a rock foundation, with intervening strata of soapstone, has undermined by wave-action, and the entire wall will have to be rebuilt. This was temporarily repaired. The end of the dam above the stone abutment was raised 8 feet and extended 32 feet up-stream and sheeted as a precautionary measure. The lock-walls have been pointed, slope-wall repaired, and the lock and approaches dredged of 4,036 cubic yards of material, part of which was placed above the dam, and the pool cleaned of snags and overhanging trees.

The following materials were expended:

4,334 linear feet white oak timber, 12 feet by 12 inches.
286 linear feet assorted timber, 12 feet by 12 inches.
406 cubic yards riprap stone.
5,900 feet B. M. white-oak sheeting.
1,900 pounds spikes.
6 barrels Portland cement.

Lock No. 4.—A new pintle was put in the lower shore-gate by submarine diver to replace a broken one. A new capstan seat was put in and gauges were cut in the walls. The operating irons were twice replaced, and the premises whitewashed. The pool was cleared of snags and overhanging trees, and the lock and approaches were dredged. From these 350 cubic yards of material were removed and placed above the dam.

The following papers accompany this report:

Report of lockages.

Estimate for repairs for the fiscal year ending June 30, 1886.

Report of commerce.

Very respectfully, your obedient servant,

D. L. SUBLETT,
Assistant Engineer.

Capt. JAMES C. POST,
Corps of Engineers, U. S. A.

Report of lockages for the fiscal year ending June 30, 1885.

Lock.	Steamboat.	Barges and flats.	Rafts.	Miscellaneous.	Total number of crafts.	Total number of lockages.
No. 1	503	385	23	159	1,070	1,070
No. 2	482	265	12	30	789	789
No. 3	432	207	15	28	753	682
No. 4	397	328	76	80	919	881
Total lockages	1,814	1,185	126	297	3,531	3,422
Passed lock No. 5	492	507	850	21	1,870	....
Total	2,306	1,692	976	318	5,401	3,422

ESTIMATE OF REPAIRS NEEDED TO MAINTAIN NAVIGATION UPON THAT PORTION OF THE KENTUCKY RIVER IMPROVED BY SLACKWATER DURING THE FISCAL YEAR ENDING JUNE 30, 1886.

Lock and Dam No. 1:	
Raising breach bank	$525
Repairing tail-bay of lock	640
Lock and Dam No. 2:	
Repairing upper guide-crib	100
Erecting guide-piles	20
Supplying gates with wicket-screws	15
Lock and Dam No. 3:	
Rebuilding lower slope-wall	750
Building two jetty-cribs	2,400
Lock and Dam No. 4:	
Resheeting, repairing, and backing dam	9,500
Rebuilding three-fourths upper shore crib	700
	14,650
Dredging and snagging	2,000
Total	16,650

Commercial statistics, Kentucky River, Kentucky, for fiscal year 1884–'85.

Articles.	Quantity.	Average price.	Value.
Cements ..... barrels	750	$1 per barrel	$750 00
Cedar posts ..... number	2,000	25 cents each	500 00
Coal ..... bushels	511,475	10 cents per bushel	51,147 50
Cross-ties ..... number	55,080	50 cents per each	27,540 00
Flour ..... barrels	2,600	$5 per barrel	13,000 00
Grain ..... bushels	213,590	65 cents per bushel	138,833 50
Gravel ..... cubic yards	6,924	$1 per cubic yard	6,924 00
Hay ..... bales	4,330	$2 per bale	8,660 00
Iron, manufacturing ..... tons	1,440	$80 per ton	115,200 00
Junk and old iron ..... pounds	50,000	2 cents per pound	1,000 00
Lime ..... barrels	2,550	95 cents per barrel	2,422 50
Logs, saw ..... number	109,853	$3 each	329,559 00
Logs, walnut ..... do	2,305	$10 each	23,050 00
Lumber ..... feet B. M.	1,920,677	$15 per thousand	28,810 15
Miscellaneous merchandise ..... tons	16,253	$100 per ton	1,625,300 00
Material, building (doors, blinds, brick, laths, &c.)	Estimated.		40,000 00
Miscellaneous, farm products	do		250,000 00
Stone, building ..... cubic yards	1,200	$2 per cubic yard	2,400 00
Stone, R. R ..... do	6,053	$1 per cubic yard	6,053 00
Stock ..... head	4,633	$40 a head	185,320 00
Staves ..... number	995,000	$40 per thousand	39,800 00
Tobacco ..... hogsheads	6,638	$120 per hogshead	796,560 00
Timber ..... cubic feet	250,632	16⅔ cents cubic foot	41,771 00
Whiskey ..... barrels	18,745	$85 per barrel	1,593,325 00
Wood ..... cords	1,950	$3 per cord	5,850 00
Passengers	16,447	$1.50 each	24,670 50
Total			5,358,446 15

E E 3.

IMPROVEMENT OF TRADEWATER RIVER, KENTUCKY.

The project for the improvement of the river, which contemplates the formation of a clear channel at least 40 feet in width, with a minimum depth of 2½ feet during eight months of the year, has been continued with the $2,000 appropriated by act of July 5, 1884.

At the close of the preceding fiscal year this work had progressed to Black Ford, 19 miles from its mouth. Owing to the continued frequent stripping of the banks, which were heavily timbered, and the resulting obstruction of the channel by fallen trees, it was determined to clear the banks to their tops, to make the slides lessfrequent and of less serious obstructions where they did occur. This was done during the preceding year as far as the mouth of Cypress Creek, and the timber on both banks was girdled as far as the river had been cleared.

During the past season operations were extended as follows: The obstructions have been removed to Montezuma, an additional distance of 12 miles, making 31 miles of the river that are navigable. The banks have been cleared 7 miles to Nunn's Ripple, making a total length of 14 miles that are now free from timber, and the timber upon the banks has been deadened the remainder of the distance to Bellville, 41 miles from the mouth, the limit to which it is proposed to carry the improvement.

The following is a summary of the work done:

Trees removed from banks	8,063
Trees girdled	34,635
Logs and snags removed	1,226

This improvement, as far as it has progressed, has resulted in a very material development of the country drained by the river, its commerce having increased at the time of my last annual report to over $700,000 annually. I have been unable to obtain complete commercial statistics for the fiscal year just closed for comparison, but from reliable sources it has been ascertained that the shipments along the river have been about the same as those for the preceding year, except the amount of the coal mines has been nearly doubled, and the products sent from Providence, one of the principal landings, have increased at least 25 per cent. This gain in the commerce has taken place, notwithstanding the unusual quantity of ice during the past winter prevented navigation for nearly two months, or about one-fourth of the portion of the year that there is usually sufficient water in the river for boats drawing 2 feet.

It is proposed to continue the work with the amount asked for.

Money statement.

July 1, 1884, amount available	$58 78
Amount appropriated by act approved July 5, 1884	2,000 00
	2,058 78
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,027 49
July 1, 1885, amount available	31 29
Amount (estimated) required for completion of existing project	8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

E E 4.

IMPROVEMENT OF BIG SANDY RIVER, WEST VIRGINIA AND KENTUCKY.

During the past fiscal year the delivery of stone under the contract with David B. Shipley has been continued and the contract nearly completed. The contractor has been greatly delayed in his work by the extreme low water in the river, which extended over an unusually long period. The excavation at the lock site was also continued and completed; 12,562.66 cubic yards of rock, 700 cubic yards of coal and slate, and 6,160.70 cubic yards of earth were removed. Early in November the masonry of the lock was commenced, and since that time nearly two-thirds have been completed. An effort was made to obtain the cement required for this work by contract. No bids were received in reply to my advertisement of July 28, 1884, for 2,000 barrels, and authority was requested and granted to purchase this amount in open market. An abstract of the proposals received on May 5, 1885, in reply to my advertisement of April 18, is inclosed.

Early in August parties were fitted out for the removal of the obstructions in the Louisa and Tug forks. In the former the channel was improved at Lost Creek, Chestnut Swirl, Vawhoose, Buffalo, Greasy, Hell's Gate, Wireman's, Hawes' Ford, and Grimes' Shoals, and at many other minor ones, and the work extended to Piketon, a distance of 87 miles. During a personal examination of the river in the month of May last the works were found to be in good condition, having received but little injury during the past winter.

On the Tug Fork, improvements were made at Endicott Shoals, White Bend, Turkey Shoal, and Crum's Mill Dam, Roman's Bend, Horseshoe Bend, Lick Shoal, Buck Creek, Wolf Shoal, Alley Island, and at many other places, the work being extended to the mouth of Pond Creek, a distance of 58 miles. The main river from Catlettsburg to Louisa was also cleared of snags and obstructions.

As a result of these improvements I am informed that steamboats can navigate the river with at least 1 foot less water than formerly, and the period of navigation has been increased about a month during each year.

In addition to the work on the Tug Fork, a survey was made from its mouth at Louisa to the "Roughs," a distance of 95 miles, and connected with a survey heretofore made of the upper portion of the river. The field work of the survey has been completed, but the drawings have not been fully prepared. For further information as to the details of the work done during the year, attention is invited to the accompanying report of Mr. B. F. Thomas, to whose excellent management the accomplishment of so much work is mainly due.

In addition to the usual statistics giving the amount of commerce between Catlettsburg and the upper portion of the river, statistics are inclosed giving the amount of freight carried by the Chattaroi Railroad to and from its terminus at Richardson, 19 miles above Louisa, which is either shipped to, or received from, various points up the river by boats.

With the amount asked for it is proposed to complete the lock and dam, and continue the improvements upon the forks of the river.

Money statement.

July 1, 1884, amount available	$79,774 01
Amount appropriated by act approved July 5, 1884	50,000 00
	129,774 01
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	108,709 48
July 1, 1885, amount available	21,064 53
Amount (estimated) required for completion of existing project	92,645 31
Amount that can be profitably expended in fiscal year ending June 30, 1887	92,645 31
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Improvement of Big Sandy River, West Virginia and Kentucky, for furnishing cement for constructing works at Louisa, Ky.

No.	Names of bidders.	Brand of cement.	Tensile strength.	No. of 300-pound barrels required.	Price per barrel.	Aggregate.
1	Silver Creek Cement Association.	Louisville ..	To 1 day old, 70 pounds To 7 days old, 120 pounds	1,500	$1 77	$2,655
2	Martin R. Coney	Alsen & Son, Portland.	....	1,125	3 40	3,825

Bids opened May 5, 1885. They were rejected, as the cement could be purchased at a lower rate in open market.

REPORT OF MR. B. F. THOMAS, ASSISTANT ENGINEER.

LOUISA, KY., *July* 1, 1885.

CAPTAIN: I have the honor to report upon the works under my charge for the fiscal year ending June 30, 1885. The improvements assigned me are the construction of a lock and dam in Big Sandy River, near Louisa, Ky., and the removal of obstructions to navigation in the Big Sandy, Louisa, and Tug rivers.

The preparation of stone for the lock and abutment, which was well started at the close of last year, has been continued vigorously, and the contract with David B. Shipley will be filled during the present month. The coffer-dam and excavation for foundation having been completed, work upon the lock masonry was begun early in November, and it is believed it will be finished in September next, the land wall being now almost completed, as is also the upper miter wall, while the river wall is well under way.

The machinery in use consists of one traveling derrick, two boilers, three engines, one pump, and six derricks, all in good condition. There have been expended 6,600 pounds dynamite, 80 kegs powder, 60,000 feet lumber, B. M., 8,500 linear feet timber, 5,500 pounds iron, 1,100 pounds steel, 2,150 pounds nails and spikes, 2,100 pounds rope, 2,218 barrels cement, and 5,223 cubic yards stone, during the year just closed.

Below will be found statement showing principal work done and its cost.

Summary of work performed, and expenses incurred therefor, at lock near Louisa, Ky., June 30, 1884, to June 30, 1885.

Class of work.	Quantity.	Cost.
Excavation, rock	12,562.66 cubic yards......	$13,996 31
Excavation, coal and slate..	700 cubic yards.	850 00
Excavation, earth	6,160.70 cubic yards.......	1,541 34
Coffer-dam..	384 linear feet.............	2,747 65
Masonry (cement and labor)..	5,223 cubic yards	11,256 32
Stone (contract)	8,032.16 cubic yards.......	47,658 76

NOTE.—This cost does not include plant or superintendence.

REMOVAL OF OBSTRUCTIONS TO NAVIGATION.

Parties were placed upon the work necessary to improve the navigation of Big Sandy River below Louisa a distance of 26 miles, Louisa Fork from its mouth to Piketon, 87 miles, and Tug Fork from Louisa to Pond Creek, 58 miles, in August and September last.

The work consists of the removal of snags and other obstructions from the channel, large rocks from the bends, overhanging and fallen trees from the shores, and the construction of wing-dams and walls for guiding and confining the water. In addition to this, the shoals were thoroughly cleaned of all bowlders and solid rock, and new chutes were constructed, thereby greatly assisting navigation during low water. The results of the season's operations are a clear and unobstructed river from Catlettsburg on the Ohio River to Piketon on Louisa Fork, and to Pond Creek on Tug Fork, a total distance of 171 miles, and craft are now enabled to navigate on 12 inches less water than formerly during ordinary stage.

Summary of principal work done on the improvement of Big Sandy River and the Louisa and Tug forks, during year ending June 30, 1885.

Class of work.	Big Sandy.		Louisa Fork.		Tug Fork.	
	No.	Length.	No.	Length.	No.	Length.
Snags removed	913	23.8	1,023	24.9	1,556	19
Fallen trees removed	461	76.5	473	72.7	480	....
Stumps removed	761	....	362	....	100	20.1
Solid rock removed	2,291	....	3,260	....	2,090	....
Loose rock removed	1,701	....	23,791	....	57,778	....

TUG RIVER SURVEY.

A survey of Tug Fork was made from its mouth at Louisa to the "Roughs," 95 miles above, where connection was made with a former survey of 5 miles above that point.

The fall of the river between points surveyed is 287 feet, or a little more than 3 feet per mile.

SUMMARY.

The close of the year finds the contract for stone within a few days of completion, the lock masonry two thirds in place, the excavation for lock and approaches about half done, the lock coffer built and in good condition, and an unobstructed river channel to the head of steamboat navigation on both forks of Big Sandy River.

I wish to note, in conclusion, my appreciation of the faithful and intelligent manner in which I have been assisted by the gentlemen in charge of the various parties sent out, as well as those who have acted in a like capacity at the lock and dam.

Respectfully submitted.

B. F. THOMAS,
Assistant Engineer.

Capt. JAMES C. POST,
Corps of Engineers, U. S. A.

Commercial statistics for fiscal year 1884–'85.

Articles.	Quantities.	Average price.	Value.
GENERAL PRODUCE.			
Apples, dried ....pounds..	36,000	4⅗ cents per pound ...	$1,656 00
Apples, green..........barrels..	435	$1.72½ per barrel......	750 37
Beeswax ....pounds..	3,800	30 cents per pound....	1,140 00
Butter .... do....	11,070	27½ cents per pound ..	3,044 25
Beans.......... do	91,390	4 cents per pound	3,655 60
Corn ....bags..	1,085	$2.30¾ per bag	2,504 68
Eggs..........cases..	3,905	$3 per case	11,715 00
Feathers..........pounds..	127,296	40 cents per pound....	50,918 40
Ginseng..........do....	27,450	$1.20 per pound.......	32,940 00
Hides, dried ....bales..	525	$5 per bale	2,625 00
Hides, green ....bundles..	125	$2 per bundle....	250 00
Honey ....pounds..	10,780	10 cents per pound ...	1,078 00
Leather..........do....	58,280	27½ cents per pound ..	16,027 00
Oats ....bushels..	955	43 cents per bushel ...	410 65
Peaches, dried ....pounds..	102,000	6¼ cents per pound....	6,375 00
Potatoes..........bags..	340	$2 per bag	680 00
Rye... ....do ...	365	$2 per bag	730 00
Roots (assorted) ....do....	1,900	$12 per bag	22,800 00
Sheep pelts ....bales..	65	$27.50 per bale........	1,787 50
Sorghum ....barrels..	5,814	$20 per barrel.........	116,280 00
Tallow .... do ...	70	$26 per barrel	1,820 00
Tobacco ....hogsheads..	21	$140 per hogshead	2,940 00
Wool..........pounds..	166,900	25 cents per pound....	41,725 00
Wheat..........bags..	14,344	$2.03½ per bag	29,190 04
Furs	330	$8.25 per bag	2,722 25
Total..........	....	....	255,764 69

Commercial statistics for fiscal year 1884–'85—Continued.

Articles.	Quantities.	Average price.	Value.
LIVE STOCK.			
Cattle .... number..	4, 820	$28 a head	$134, 960 00
Chickens .... do....	56, 100	18¾ cents each	10, 519 00
Ducks .... do....	561	20 cents each	112 20
Geese .... do....	612	40 cents each	244 80
Hogs .... do....	3, 554	$8 each	28, 432 00
Horses .... do....	338	$80 each	27, 040 00
Mules .... do....	107	$100 each	19, 700 00
Sheep .... do....	2, 337	$2 each	4, 674 00
Turkeys .... do....	1, 865	80 cents each	1, 492 00
Total	....	....	218, 174 00
TIMBER.			
Ash logs .... cubic feet..	42, 925	10 cents per cubic foot.	4, 292 50
Poplar .... do....	3, 492, 240	12½ cents per cubic foot.	436, 530 00
Oak .... do...	561, 000	10 cents per cubic foot.	56, 100 00
Walnut .... number..	7, 260	$12.50 each	90, 750 00
Mixed .... cubic feet..	103, 200	10 cents per cubic foot.	10, 320 00
Total.	....	....	597, 992 50
LUMBER.			
Ash .... feet B. M..	63, 750	10 cents per foot	6, 375 00
Black walnut	....	....	74, 125 00
Poplar .... feet B. M..	507, 500	10 cents per foot	505, 750 00
Total	....	....	586, 250 00
MISCELLANEOUS.			
Knots, black walnut	....	....	1, 000 00
Hoop poles, barrel .... number..	38, 000	$10 per M	380 00
Hoop poles, tierce .... do....	20, 000	$15 per M	300 00
Hoop poles, hogsheads .... do....	10, 000	$20 per M	200 00
Tan bark .... cords..	900	$10 per cord	9, 000 00
Staves, assorted .... number..	5, 508, 000	$20 per M	110, 160 00
Total	....	....	121, 040 00

SUMMARY.

Produce	$355, 764 69
Live stock	218, 174 00
Timber	597, 992 50
Lumber	586, 250 00
Miscellaneous	121, 040 00
Total value of exports	1, 879, 221 19
Total value of imports	857, 981 21
Total	2, 737, 202 40

Commercial statistics of upper river commerce with railroad for fiscal year 1884–'85.

Articles.	Quantities.	Average price.	Value.
Beans .... pounds..	442, 009	4 cents per pound	$17, 680 36
Beeswax .... do....	6, 466	30 cents per pound	1, 939 80
Eggs .... cases..	497	$3 per case	1, 491 00
Feathers .... pounds..	20, 629	40 cents per pound	8, 251 60
Fruit, dried .... do....	179, 436	4 cents per pound	7, 177 44
Hides .... bales..	245	$5 per bale	1, 225 00
Roots .... bags..	1, 291	$12 per bag	15, 492 00
Sorghum .... barrels..	2, 140	$20 per barrel	42, 800 00
Salt .... do....	607	$1 per barrel	607 00
Stock .... pounds..	145, 550	5 cents per pound	7, 277 50
Wheat .... bags..	713	$2 per bag	1, 426 00
Wool .... pounds..	18, 924	25 cents per pound	4, 731 00
General merchandise .... tons..	1, 417	$100 per ton	141, 700 00
Total	....	....	251, 798 70

E E 5.

IMPROVEMENT OF GUYANDOTTE RIVER, WEST VIRGINIA.

By act of July 5, 1884, $2,000 was appropriated for continuing the improvement heretofore commenced.

In my previous annual report mention has been made of a dangerous obstruction known as Rogers's Mill Dam, 13 miles from the mouth of the river. This dam is private property, having been erected under the laws of the State of Virginia before the division of the State. It cannot be removed except by appealing to the State courts, a long and tedious process attended with uncertain results, or by purchase. The desire of all those interested in this improvement is that it should be purchased with the money now available, but it was impossible to do this without the sanction of Congress. Mr. Rogers asks $2,000 for the dam, and the raftsmen offer, if the purchase is made, to remove it at their own expense. Fearing if this money was expended upon other portions of the river Mr. Rogers would repair his dam, which is now in a dilapidated condition, and thus increase the difficulties of obtaining its removal, I have been requested by the Hon. C. P. Snyder, member of Congress representing the district, to reserve the money and await the action of Congress. This request has been complied with, and no work has been done during the past fiscal year. In my former reports I have also called the attention of Congress to the existence of another dam, known as Peck's Mill Dam, which is also a serious obstruction to the navigation of this river. I again renew my recommendation that authority be granted for the purchase of both Rogers's and Peck's dams. It is probable that the second one can be removed upon the same terms as the first.

With the amount asked for it is proposed to purchase the dams and complete the improvement of the river.

The commercial statistics for the year are forwarded herewith.

Money statement.

Amount appropriated by act approved July 5, 1884	$2,000 00
July 1, 1885, amount available	2,000 00
Amount (estimated) required for completion of existing project	8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	8,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Commercial statistics, improving Guyandotte River, West Virginia, for fiscal year 1884–'85.

Articles.		Quantity.	Average.	Value.
Apples	barrels	10,000	$1.25 per barrel	$12,500
Peaches	bushels	6,000	$1 per bushel	6,000
Potatoes	do	15,000	40 cents per bushel	6,000
Corn	do	40,000	40 cents per bushel	16,000
Rye	do	1,000	40 cents per bushel	400
Wheat	do	6,000	75 cents per bushel	4,500
Feathers	pounds	36,000	50 cents per pound	18,000
Wool	do	55,000	40 cents per pound	22,000
Tanbark	cords	800	$12 per cord	9,600
Ginseng	pounds	20,000	$1 per pound	20,000
Roots, various kinds				20,000
Poplar saw-logs	cubic feet	1,600,000	12 cents per foot	192,000
Lumber, sawed	feet	7,500,000	$12 per M	90,000
White Oak logs	feet, B. M	7,860,000	$14 per M	110,040
White Oak staves	number	2,667,000	$15 per M	40,005
Walnut logs	do	10,000	$12.50 each	125,000
Tobacco	pounds	312,500	8 cents per pound	25,000
Total exports				717,045
Total imports				500,000
Total				1,217,045

E E 6.

IMPROVEMENT OF LITTLE KANAWHA RIVER, WEST VIRGINIA.

The act of Congress of July 5, 1884, appropriated $31,000 for this river, with the following proviso:

> But no toll shall be collected by any person, or corporation, for this improved navigation, and such right, if any exists, shall be relinquished in a manner satisfactory to the Secretary of War, before the expenditure of said sum.

The Little Kanawha Navigation Company, the owner of the slackwater improvements on this river upon being informed of this condition executed a formal relinquishment of its right to collect tolls upon that portion of the river above the head of the present slackwater navigation. This was duly submitted and accepted as being sufficient to render the amount available under the restriction stated in the act, but the decision was rendered too late to begin the construction of the lock last season. Operations were heretofore confined to the cutting of stone, the expense being paid from the balance remaining on hand at that time from the previous appropriation. During the season 1884 cubic yards were cut.

Early in spring preparations for beginning work on the lock were commenced, and at the close of the fiscal year the necessary machinery was in place, and the coffer-dam for the foundation was a little more than half completed.

It is proposed during the present season to begin the construction of the lock and carry the work forward as far as the amount available will permit. The upper miter-wall will be built, and as much as possible of the river-wall will be raised to the same height. It is to be regretted that the appropriation is not large enough to complete the lock, or bring it to a sufficiently advanced state to dispense with the use of the coffer-dam next season. The natural result of leaving the work in such an unfinished condition, to withstand the action of the frost and freshets, will be deterioration, and this will probably add at least 10 per cent. to the estimated cost of this lock and dam before they can be put in operation.

With the amount asked for it is proposed to continue the construction of the lock and dam and complete them, if practicable. The works constructed to improve the upper river will also be repaired.

The commercial statistics of the commerce of the river for 1884-'5 accompany this report.

Five abstracts of proposals received for the various materials required are inclosed herewith.

Money statement.

July 1, 1884, amount available		$40,976 95
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$20,289 78	
July 1, 1885, outstanding liabilities	5,236 14	
		25,525 92
July 1, 1885, amount available		15,451 03
Amount (estimated) required for completion of existing project		55,173 02
Amount that can be profitably expended in fiscal year ending June 30, 1887		55,200 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

For furnishing boilers and machinery for constructing Lock No. 5, Little Kanawha River, West Virginia.

No.	Names of bidders.	For boilers, engines, and pumps complete.	For boilers complete.	For pumps and engines complete.	Total.
1	Portsmouth Foundry and Machine Works	$2,435 10			$2,435 10
2	Ainslie, Cochran & Co	2,700 00			2,700 00
3	Lambert Bros. & Co	3,049 00			3,049 00
4	Bair & Gizzam	3,223 50			3,223 50
5	Francis Frich	3,275 00			3,275 00
6	Ramsay Engineering Works	3,372 00	$1,197	$2,175 00	3,372 00
7	J. & E. Greenwald	3,475 00			3,475 00
8	The Tanner and Delaney Engine Company	3,560 00			3,560 00
9	Samuel J. Pope & Co	3,679 00	1,339	2,340 00	3,679 00
10	Cavett & McKnight	3,692 00			3,692 00
11	Hamlin F. Frisbie	3,995 00			3,995 00
12	The York Manufacturing Company	4,635 69		2,404 69	
13	B. C. Howell	5,450 00	1,925	3,700 00	5,625 00
14	James Rees		1,325	3,200 00	4,525 00
15	Henry Strecker		1,500		
16	Warden & Michell		1,625		

Bids were opened April 9. Contract was awarded to Portsmouth Foundry and Machine Works, of Portsmouth, Ohio, and executed under date of April 29, 1885.

For furnishing cement for the construction of Lock No. 5, Little Kanawha River.

No.	Names of bidders.	Brand of cement.	Tensile strength.	Number of barrels required.	Price per barrel.	Aggregate amount.
1	S. M. Hamilton & Co	Cumberland	For one day, 50 pounds For seven days, 120 pounds	3,000	$1 40	$4,200
2	Silver Creek Cement Corporation	Louisville	For one day, 75 pounds For seven days, 110 pounds	3,000	1 52	4,560
3	S. M. Hamilton & Co	Union	For one day, 80 pounds For seven days, 140 pounds	3,000	1 70	5,100
4	S. L. Merchant & Co.*	Imported Portland.	For one day, 91 pounds For seven days, 271 pounds	3,000	2 80	8,400

* Informal; no bond, and but one copy of bid received.

Bids opened April 9, 1885. Contract was awarded to S. M. Hamilton & Co., of Baltimore, Md., and executed May 7, 1885.

For furnishing sawed lumber for constructing Lock No. 5, Little Kanawha River.

Name of bidder.	Sheet-piling and flooring, 77,270 feet.		Boxing, 10,400 feet.		Scantling and 1-inch plank for house and shed, 8,510 feet.		Aggregate.
	Price per 1,000 ft. B. M.	Amount.	Price per 1,000 ft. B. M.	Amount.	Price per 1,000 ft. B. M.	Amount.	
Alexander J. Michell	$19 19	$1,482 80	$17 09	$177 73	$17 09	$145 43	$1,805 96

Bids opened April 30, 1885. Contract awarded to Alexander J. Michell, Burning Springs, W. Va., and executed under date of May 9, 1885.

For furnishing timber for constructing Lock No. 5, Little Kanawha River.

Name of bidder.	Stringers and ties, 19,869 feet.		Piles, 3,081 feet.		Locust timber for pins, 300 feet.		Aggregate.
	Price per linear foot.	Amount.	Price per linear foot.	Amount.	Price per linear foot.	Amount.	
	Cents.		*Cents.*		*Cents.*		
Alexander J. Michell	*10	$1,986 90	9½	$292 69	19	$57 00	$2,336 59

* Afterward changed to 8 cents.

Bids opened April 30, 1885. Contract awarded to Alexander J. Michell, Burning Springs, W. Va., and executed under date of May 14, 1885.

For furnishing coal for the construction of Lock No. 5, Little Kanawha River.

No.	Names of bidders.	Kind of coal.	Quantity.	Price per bushel.	Amount.	Remarks.
			Bushels.	*Cents.*		
1	John Moren	Nut	12,000	15	$1,800	To be unloaded by contractor.
2	Morris & Co	Youghiogheny lump	12,000	8½	1,020	To be unloaded by United States.

Bids opened May 7, 1885. Contract awarded to Morris & Co., of Allegheny City, Pa., and executed under date of May 8, 1885.

Commercial statistics, improving Little Kanawha River, West Virginia, for fiscal year 1884-'85.

Articles.	Quantity.	Average price.	Value.
Coal ... bushels	31,500	8 cents per bushel	$2,520 00
Cross-ties ... number	232,920	30 cents each	69,876 00
Rafts (timber) ... cubic feet	1,855,000	10 cents per cubic foot	185,500 00
Lumber (manufactured) ... feet	2,567,700	$25 per thousand	64,192 50
Staves ... number	1,497,000	$18 per thousand	26,946 00
Keg-wood ... cords	1,090	$4 per cord	4,360 00
Oil (petroleum) ... barrels	3,200	$1 per barrel	3,200 00
Passengers ... number	21,096	75 cents each	15,822 00
Miscellaneous freight ... tons	2,711	$100 per ton	271,100 00
Total			643,516 50

Navigation was partially suspended by low water for forty-two days and by ice twenty-four days.

E E 7.

IMPROVEMENT OF BUCKHANNON RIVER, WEST VIRGINIA.

By act approved July 5, 1884, Congress appropriated $1,500 for improving the Buckhannon River.

This river is 24½ miles long from Buckhannon, which is the principal town in this portion of the State, to the Three Forks, and in this distance the main obstructions were found. The course of the river is through a heavily wooded, mountainous district, containing much valuable timber of immense size. This can only reach a market by being floated out during the periods of high water to Buckhannon, the terminus of the Buckhannon and Western Railroad. Heretofore the difficulties encountered have made it impossible to obtain the timber except in short lengths, and even then so large a percentage was lost that after continued trials and considerable expenditure parties interested were about to abandon the locality. This would probably have resulted in the destruction of the timber, as it would have been burned in clearing the land.

Work was commenced above Buckhannon and extended over a distance of 7 miles to a point about 12 miles above the town. In this portion ten islands were cleared, eleven log-jams cut out, and 10,296 cubic yards of rock broken up. A channel 30 feet wide and containing a minimum depth of 2 feet during four months of the year was made.

Before these improvements were commenced under the most favorable conditions only about 115,000 linear feet of timber had been brought out in any one year. During the past season, although it was late before the work was completed, this amount was increased to 900,000 linear feet, or nearly eight times as much as previously.

With the amount asked for it is proposed to continue the improvement.

Money statement.

Amount appropriated by act approved July 5, 1884	$1,500 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,453 37
July 1, 1885, amount available	46 63
Amount (estimated) required for completion of existing project	23,955 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	3,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

E E 8.

PRELIMINARY EXAMINATION OF ROUGH RIVER, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, *Ohio*, *October* 21, 1884.

GENERAL: In accordance with instructions contained in your letter of July 31, 1884, I have the honor to submit a report on the preliminary examination of the Rough River, Kentucky.

The Rough River, formerly known as Rough Creek, is one of the principal tributaries of the Green River, and drains a large portion of Hardin, Breckenridge, Grayson, and Ohio counties in the State of Kentucky. It flows westward in an exceedingly tortuous course, and is about 96 miles in length from its forks to the Green River. Its width varies from 100 to 200 feet, and the channel is shoal in low water and obstructed by bars or ripples. At present there are three mill-dams upon this stream, and the remains of a fourth, all of which were constructed by authority of the State. These are as follows: Phipp's dam, located at Hartford, 28 miles from the mouth; Taylor's or Hines' dam, 55 miles, remains of Lundrum's Dam, 72 miles, and Green's dam, 81 miles from the mouth.

During high water steamers make occasional trips up the river as far as Hartford, to supply the country and carry off its productions. These latter cannot reach a market, except by the river, unless they are carried over rough roads a distance of from 5 to 20 miles to the Chesapeake, Ohio and Southwestern Railroad.

The official statistics of the counties mentioned give the amount of their productions for the year 1883 as follows:

County.	Tobacco.	Hemp.	Hay.	Corn.	Wheat.	Barley.
	Pounds.	*Pounds.*	*Tons.*	*Bushels.*	*Bushels.*	*Bushels.*
Ohio	2, 532, 190	1, 000	4, 153	921, 594	106, 205	....
Grayson	1, 092, 875	....	1, 452	641, 625	111, 017	....
Breckenridge	3, 221, 500	....	2, 638	870, 395	156, 418	4, 000

I am reliably informed that one-half of the products of Ohio County, one-third of those of Grayson County, one-fourth of those of Breckenridge County, would naturally find an outlet by the river if it was improved.

At present, as the periods of high water are uncertain, and consequently the few trips that it is possible for steamers and flats to make, very irregular, the majority of the products are carried to the railroad for shipment. The expense of hauling them so great a distance and the high charges for transportation by rail have been a serious obstacle to the prosperity of this section.

With the facts now before me I regard this stream "worthy of improvement," and therefore recommend that a more thorough examination and a survey, if necessary, be made. It is estimated that the cost of making the survey and continuing the examination will be $300.

Very respectfully, your obedient servant,

JAS. C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

SURVEY OF ROUGH RIVER, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, January 27, 1885.

GENERAL: I have the honor to submit a report upon the survey of Rough River, Kentucky, which has been assigned to me.

Rough River is one of the principal tributaries of the Green River, Kentucky, and lies wholly within that State. It rises in Meade, Hardin, and Breckenridge counties, and, flowing westward in an exceedingly tortuous channel, empties into the Green River at Livermore. Its length is about 126 miles, and it is estimated that it drains an area of 700 square miles.

In 1836 this river was surveyed by Hon. H. D. Taylor, of Hartford, under the direction of the principal engineer of the Green and Barren Navigation Company, from Hartford 28 miles from its mouth to Lampton's old mill, a distance of 86 miles. Previous to this the lower portion had been surveyed by a Mr. Foster. Both these surveys were made with a view of improving the navigation of the river with locks and dams.

Twenty years later a company known as the Rough Creek Navigation and Manufacturing Company was granted a charter by the State of Kentucky. This corporation built one lock and dam about 7 miles from the Green River, and this with the back water from Dam No. 2, Green River, gave navigation throughout the year to Hartford for boats with a draught not greater than 3¼ feet.

The history of this lock is given in a letter written by Judge A. B. Baird, of Hartford, printed in the report of Maj. W. E. Merrill, Corps of Engineers, Report of Chief of Engineers for 1880, page 1814, from which the following extract is taken:

> A stock company built a lock on the creek 8 [7] miles above the mouth, shortly after the war, that gave slackwater to Hartford, and numerous steamers ran in the creek making regular trips and doing a large business, and one that was profitable alike to the steamers and shippers. These steamers were from 100 to 125 feet long, and during the whole time navigation was kept up not one single accident occurred. But when Green River was transferred to a company the tolls were made so high that the boats were all compelled to leave the creek. The steamers having left, the lock was not worth attending to, was abandoned by the company, and the work went down.

This lock, dam, and abutment were built of timber cribs, and are now in ruins. The débris of the dam has been cleared away for the passage of boats, and during each season of high water, steamers make occasional trips up the river as far as Hartford. From information recently obtained, I have learned that a steamer is now making regular trips between Hartford and Evansville, Ind., the water being high, and the Green and Barren Navigation Company having made satisfactory rates, and also that the Louisville and Nashville Railroad, crossing the Green River at Livermore, mouth of the Rough River, is making exceedingly low offers for the Rough River trade.

The original project for the improvement of Rough River, according to the report of Mr. Taylor, was the construction of a sufficient number of locks and dams to extend slackwater navigation to Green's dam, 81 miles from its mouth. In this distance the river has a fall of 65.1 feet, or an average of 8.04 inches to the mile. Reducing this fall by the height of the back water from Pool No. 2, Green River, which according to Mr. Taylor's report was taken at 7 feet, there remains but 60 feet of lift required to obtain nearly 2 feet of water upon the ripple at Green's dam. If suitable sites could be found this height could easily be obtained with five locks and dams by giving them an average lift of 12 feet.

From the mouth to Hartford the river is unobstructed, and the construction of one dam, as has already been mentioned, with a lift of 9 feet, gave ample water to Hartford. Not being able to obtain a copy of Mr. Foster's report, a survey of this portion of the river has recently been made by Mr. A. L. Duvall. This last survey shows about 16 inches less fall in this section than that reported by Mr. Foster. This discrepancy can readily be accounted for by the probability that Dam No. 2, Green River, which was completed subsequently to his report and that of Mr. Taylor's, has been made higher than he calculated, and consequently backs the water to a higher level in Rough River. This would make a corresponding diminution in the total lift required to reach Green's Mill.

Above Hartford the river is obstructed by three mill-dams and the remains of a fourth, all of which I have been informed were constructed under the laws of the State of Kentucky. There are Phipp's Dam, immediately above Hartford; Taylor's Dam, 27 miles above; Lundrum's Dam (now in ruins), 44 miles above Hartford; and Green's Dam.

The reports of both Mr. Taylor and Mr. Duvall are forwarded herewith, and are interesting papers descriptive of the river. Attention is invited to them for further details. Mr. Taylor's contains an estimate for the construction of the locks and dams necessary to extend slackwater navigation to Lampton's old mill, a distance of 114 miles. He undoubtedly contemplated timber locks, dams, and abutments, and estimates their cost at $302,522. To improve the portion of the river between the mouth and Green's Mill in the same manner, he places the cost at $200,288. In Mr. Duvall's report an estimate is submitted for a masonry lock, and timber dam and abutment, that will give slackwater navigation of 4 feet to Hartford. With a pile foundation he places the cost of these works at $80,964.40, and if a good natural foundation can be obtained at $50,729.80.

Should Congress decide upon the construction of locks and dams upon this river, it is recommended that the locks be built of masonry and the dams and abutments of timber, as suggested in Mr. Duvall's report. Timber locks will need constant repairs, while masonry locks, although the first cost is somewhat greater, are much more economical structures, as the walls when completed require little or no expense to keep them in order.

Mr. Duvall's estimate for the first lock and dam I consider a fair one, and it may be taken as the basis of the cost of any others that may be determined upon. The estimate for five locks and dams necessary to extend navigation to Green's Mill, and for clearing the banks of the river, will therefore be as follows:

Five locks and dams upon natural or rock foundation	$253, 649
Clearing banks, 81 miles, at $200 per mile	16, 200
Total	269, 849
Five locks and dams upon pile foundation	404, 822
Clearing banks, 81 miles, at $200 per mile	16, 200
Total	421, 022

Although the obstruction of the river by mill-dams above Hartford may be thought to render it unadvisable to continue the improvement above that place, I have considered it best to submit for the information of Congress an estimate for extending slackwater navigation to Green's Mill. According to Mr. Taylor's survey the sites of these dams are favorable locations for the locks and dams necessary for this navigation, and if some arrangement could be entered into with the parties owning the mill privileges, three of them might be used for this purpose, without interfering with the use of the mills. These, with one additional site, would complete the system necessary.

Accompanying this report is a letter signed by a number of citizens of Hartford and vicinity, giving a statement of the commerce likely to be carried upon this river, if it is improved by slackwater to Green's Mill. It enumerates the various products of the country drained, and estimates their value at over $1,000,000 annually.

The charter granted to the Green and Barren Navigation Company by the State of Kentucky gives it control not only of these rivers but also of their tributaries. The superintendent of this company in a letter to Judge Baird, a copy of which is also inclosed, states that the company is willing to surrender the control of the Rough River. I would suggest that before any appropriation is made available, a formal deed of relinquishment to the United States of the control of this river be obtained from this company. With this condition imposed, the commerce of the Rough River would not only be free from any tax that the Green and Barren Navigation Company might otherwise place upon it, but it would also enable the commerce to find an outlet either by means of the Louisville and Nashville Railroad at Livermore, or by the Green River through the Navigation Company's locks, whichever might be most to its advantage.

Copies of the following acts of the Legislature of Kentucky are forwarded with this report, viz:

I. An act to grant the consent of the State of Kentucky to the acquisition by the United States of certain lands bordering on Rough River.

II. An act to change the name of Rough Creek in Ohio, Grayson, and other counties, to that of Rough River.

III. An act to vacate and annul an act entitled "An act to incorporate the Rough Creek Navigation and Manufacturing Company."

Five sheets of drawings,* giving general outlines of Rough River, and one detailed drawing,* showing location of old lock and dam, also accompany this report.

Very respectfully, your obedient servant,

JAMES C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER OF MR. H. D. TAYLOR.

BOWLING GREEN, KY., *December 8*, 1836.

DEAR SIR: Not having expected to report to you further than the fall and distance of the several water-courses which I surveyed, my attention was therefore principally drawn to these facts, and my exertions directed toward accomplishing as many surveys as possible, in order to have the whole of Green River and its tributaries surveyed in time for legislative action.

In order to facilitate this object I found it advisable to separate our party, sending the surveyor to meander the streams, and taking the nearest and best route through the country with the level, touching the stream to make bench marks and ascertain the fall at various points. This course, although it greatly expedited the process of leveling, it is obvious, prevented a minute examination of the stream, consequently any views or suggestions which I may offer must be crude and undigested.

Annexed hereto is a tabular view of the distances and fall of each stream from point to point, containing in the first column the distances between those points; in the second, their total distance from Green River; in the third, their elevation, and in the fourth, the total elevation of the stream to those points. * * *

Both the survey and leveling of Rough Creek were commenced at Mr. Foster's first bench, a short distance below the town of Hartford.

It will be seen by a tabular view of this stream that I have divided it into seven different sections, but before they are taken up in detail it may be well to give some of the principal features of the streams, applicable to most of the sections, and which may avoid repetition hereafter. The banks of Rough Creek are uniformly higher and better than any of the streams tributary to Green River, averaging from 20 to 23 feet for the first 60 or 70 miles, and from 25 to 30 feet above low water from that to Lampton's Mill.

Few if any of the bottom lands are sufficiently low to be flooded by lifts of from 12 to 16 feet.

This stream is winding and circuitous in course throughout its whole extent, but never, except perhaps in very few instances, so abrupt in its bends as either Pond River or Muddy River.

Upon Section No. 1, from the mouth to Hartford, I have not been with a view to make examinations as to its improvement, our survey commencing near its termination. Herman's Ford is thought to be a good location for the first lock and dam, and that materials can be procured close at hand. Ross's Ripple may be considered as the termination of the third natural division of this stream. Either Hartford or Vall's (Phipp's) Mill, immediately above, may be considered as a good site for the second lock and dam.

A rock bottom and a bluff bank can be had at either place. A quarry of the best quality of sand stone has been opened on the stream a short distance above, whence it can easily be conveyed by water to the place needed.

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*Omitted.

Section No. 2, from Hartford to Hedge's Ford, perhaps embraces the most crooked part of the stream. A "cut-off" has been formed across a considerable bend, and may now be considered as the main channel. Two others are now forming and would require little labor to complete them, which would shorten the distance considerably, and several abrupt bends could thereby be avoided. Hedge's Ford is a good site, and materials could be procured at no great distance.

Section No. 3, from Hedge's Ford to Taylor's (Hine's) Mill, is for part of the way very crooked. Should it be deemed necessary to construct a lock and dam at these mills, a good rock bottom can be obtained, but the banks, though high, are composed only of clay and gravel. Materials can easily be procured at this point.

Section No. 4, Taylor's Mill to Lundrum's Mill, includes the mouth of Caney Creek, a stream of considerable magnitude, offering a descending navigation of 30 or 35 miles for flat-boats, running through the northeast part of Ohio, and extending through the southeast part of Grayson, and affording the nearest water communication to a small portion of Butler County. This stream has its course through a finely timbered portion of country, abounding in coal, and it is believed that iron ore in the greatest abundance can be procured in its vicinity. Owing to its gentleness of current and height of banks, no doubt can be entertained that it may easily be made navigable by slackwater, and will at some future day be thought worthy the attention of the legislature. Should it be found practicable to construct a lock and dam on Rough Creek, near its mouth, a slackwater navigation of 10 or 12 miles would thereby be afforded it. A good location with abundant materials can be obtained at this point. Lundrum's Mill, at the termination of this section, would afford a good site. A fine bluff of rock adjoins the stream a short distance below.

Section No. 5, from Lundrum's Mill to Green's Mill, or the Great Falls, includes also Hite's Falls, which intervene a short distance from Lundrum's Mill. Immediately below these falls is an extensive gravel bar, much the highest on the right bank, but forming a bed across the channel, entirely damming the stream in low water, which has sought another outlet around a small island to the left.

At high water the current sets against the head of this island, and boats in attempting to avoid it are thrown upon the bar or drawn into the shoot around the island, which is too narrow for their passage.

Should a lock and dam be constructed at Lundrum's Mill, it will throw sufficient depth of water over this bar to obviate all difficulty in passage.

Although the width of the bottom diminishes, this, with sections Nos. 2, 3, and 4, may be considered as constituting the second natural division of this stream.

Sections Nos. 5 and 6, from the Great Falls to Lundrum's Mill, may be considered together, as maintaining the same general characteristics, and as clearly within the first division of this stream. From these falls it appears to be only a channel between stupendous hills and precipitous bluffs, the current almost continually washing a bluff upon one or the other side, and never affording a valley of any width.

This may be considered as the only limestone region thus far up the stream.

Another fact is worthy of notice upon this portion of the stream, and does not occur anywhere else—the banks sometimes contain sinks and subterraneous cavities, which would require judicious localities to prevent the water from escaping around the dams.

About 10 miles above the Great Falls the north fork forms junctions with the main stream. This affords a descending navigation of about 20 miles for flat-boats, and is thought capable of further improvement. There is no doubt, also, that Rough Creek can be rendered navigable by slackwater to a point far above the termination of our survey. I discovered little diminution in the width of the stream, and an ample supply of water. Some few small islands, or rather tow-heads, occur in this stream, but none of any magnitude. It will be seen that this stream has its origin in Hardin County, and for some distance from its source is said to afford fine water-power and excellent sites for all kinds of machinery, which would no doubt be taken advantage of were a good navigation secured below. It forms the boundary line between Breckenridge and Grayson and runs through near the center of Ohio County. Throughout nearly its whole course it passes through one of the most finely-timbered regions in the Western country, and were locks and dams constructed and a portion of the surplus water applied to sawing plank and lumber, a traffic would immediately spring up in these articles surpassing, perhaps, the whole present trade of the country. Coal of the best quality is to be met with in every direction, and must shortly form a profitable export. Copperas is also abundant, and there is no doubt that iron ore exists in great quantities. From Green's Mill, *i. e.*, the Great Falls, to the mouth, and in fact upon every tributary between those points, are wide-spread bottoms, which experience has proved to be the best of grass and grazing lands. Hay has always commanded, and must continue to command, fine prices in the Southern market; the exportation of this article, which would be the result of improving the stream, would be a lucrative employment for the owners of these lands. These are some of the articles of commerce which for the want of a better mode of conveyance to market have lain dormant. The stream of late years has been obstructed by high mill-dams, which have rendered the descending trade so uncertain that an estimate of its present exports, were I able to give it correctly, would form no data from which to ascertain the extensive traffic that must immediately spring up were certain navigation insured. Maps of the several streams surveyed by our party are now in progress and will be forwarded you as soon as completed.

H. D. TAYLOR.

Mr. ALONZO LIVERMORE,
Principal Engineer of Green and Barren Navigation.

Number of section.	Boundary of section.	Distance from point to point in miles and decimals.	Total distance from Green River.	Elevation at the termination of each section in feet and decimals.	Total elevation from Green River.	Remarks.
1	From mouth to Hartford	28.00	28.00	17.056	17.056	As per Foster's report.
2	From Hartford to Hedge's Ford	17.00	45.00	13.782	30.838	
3	From Hedge's Ford to comb of Taylor's (Hine's) Dam.	10.25	55.25	13.454	44.292	Whole fall of dam and ripple, 7.908.
4	From Taylor's to pool of Lundrum's Dam.	16.50	71.75	12.265	56.575	Whole fall of dam and ripple, 5.320.
5	From Lundrum's to comb of Green's Dam.	9.50	81.25	21.952	78.509	Whole fall of dam and ripple, 13.354.
6	From Green's to Frank's old mill	23.25	104.50	10.927	89.436	
7	From Frank's to Lampton's old mill.	9.75	114.25	11.591	101.027	

ESTIMATE.

From the mouth to Lampton's Mill, distance 114 miles, the total lockage 101 feet, 7 feet of which will be overcome by Dam No. 2, in Green River, leaving 94 feet to be overcome by future works. This stream will be divided into two divisions.

First division.—From the mouth of the stream to Green's Mill, in Grayson County, distance about 81 miles and a lockage of 60 feet. The banks are highly favorable for high lifts; hence five dams and locks will be sufficient to make slackwater this distance.

The locks should be made 22 feet wide and 120 in the chamber. The dams will be about 110 feet long, and the whole estimated cost, including all items, $9,500 each. Clearing the banks is worth $180 per mile.

60 feet of lockage, at $2,000 per foot	$120,000
5 dams, at $9,500 each	47,500
81 miles clearing banks	14,580
	182,080
Add 10 per cent. for contingencies	18,208
Total cost of first division	200,288

Second division.—Distance 33 miles and 34 feet of lockage. This division can be made slackwater with two dams, which may be estimated to cost the same as the first division. Clearing banks also the same per mile.

34 feet lockage, at $2,000 per foot	$68,000
2 dams, at $9,500 each	19,000
33 miles clearing banks	5,940
	92,940
Add 10 per cent. for contingencies	9,294
	102,234

RECAPITULATION.

First division	$200,288
Second division	102,234
	302,522

REPORT OF MR. A. LESLIE DUVALL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, January 22, 1885.

SIR: I respectfully submit the following report of a survey of Rough River, Kentucky, made in accordance with your orders, from Phipp's Mill (a little over half a mile above Hartford, Ohio County, Kentucky) to its mouth, at Livermore, McLean County, Kentucky, a distance of 29¾ miles.

I began the survey December 23, 1884, and completed it January 3, 1885. I was delayed several days by ice and very bad weather combined.

I ran a compass line, following all the bends in the river (which is very crooked), and a line of levels along the banks, taking bottom and surface elevations at convenient points, so as to construct a profile, and put in substantial bench-marks, well described, and located about 3 to 3½ miles apart.

The banks of this river are alternately high and low, and are generally covered with a good growth of timber, and in many places thickets and cane-brakes.

This river varied in width at water-surface (at time of survey) from 80 to 173 feet, the narrowest part being under the bridge at Hartford. It was 113 feet wide at Phipp's mill-dam, and 173 feet at its mouth, where it empties into Green River at Livermore. It receives seven tributaries between Hartford and its mouth, six of which are above the old lock and dam, the ruins of which are 7 miles above Livermore. Four of these streams—viz, Muddy and Grassy creeks on the left, and No Creek and Barnett's Creek on the right—are considerable tributaries. The dimensions of the old lock and dam, as near as I could get them, are as follows: Length over all 177.8 feet; width of lock-chamber, 32 feet; distance between quoins, 134.8 feet; present height of lock-walls above lower miter-sill, 14 feet; land-wall, 10 feet thick, with counterforts at each end 8 feet wide running back 60 or more feet from face of wall. The river-wall is 13 feet thick.

This lock is of timber crib-work filled with broken stone, and is now in ruins.

The dam, as near as I can judge, was about 90 feet long, one end resting at the head of the river-wall and the other on a crib abutment, and had a 9-foot lift.

The distances between principal points via the river are as follows: From Phipp's Mill to Hartford, 3,040 feet, or a little over one-half mile; from Hartford to old lock and dam, 22½ miles; from Hartford to Livermore, 29½ miles; from old lock to Livermore, 7 miles. The distance in a straight line from Hartford to the old lock is 9.25 miles, and from Hartford to Livermore it is 12.88 miles.

The elevations are as follows: Taking the lower miter-sill of the old lock referred to as zero, then the pool below the old lock with the water at crest of Dam No. 2 at Rumsey, on Green River, would be 3.22 feet, which is evidently the amount of water expected over this miter-sill. The elevation of a pool at Hartford with 4 feet of water over the ripple at that place would be 11.96 feet, showing a fall of 8.74 feet. Therefore it would require a dam of 8.74 feet lift at the old lock, or with its crest at an elevation of 11.96 feet above the present lower miter-sill of said lock to give 4 feet of water over the ripple at Hartford. I therefore estimated that the lift of the old dam was 9 feet.

The lift of the dam at Phipp's Mill with 4 feet of water over Hartford Ripple is 7.62 feet, making the elevation of the pool above that dam 19.58 feet above lower miter-sill of old lock, or a fall of 16.36 feet from the pool above Phipp's Mill to the pool below old lock or the back-water from Dam No. 2 at Rumsey, on the Green River, when the water is level with the crest of said dam.

There is a coal-bank opened 4½ miles below Hartford, and a coal out-crop at the Narrows, 2 miles further down.

I do not know of any other places where there is coal so convenient to the banks of the river, and am not aware that any shipments of coal have been made via the river from the bank opened. There are evidently large timber and stave shipments on this river, judging from the logs and rafts cut and floating, and the number and capacity of the stave-yards I passed while making the survey.

I have not sufficient data to make any statement as to present or prospective commerce beyond that just mentioned above.

I submit herewith two estimates for the construction of a stone lock and timber crib-dam and abutment, one if the foundation should be rock, and the other if it should be necessary to build on pile and timber foundation. I also append an estimate for clearing the banks of overhanging trees and for snagging from the mouth of the river to Hartford.

Very respectfully, your obedient servant,

A. LESLIE DUVALL,
Assistant Engineer.

Capt. JAS. C. POST,
Corps of Engineers, U. S. A.

ESTIMATE FOR THE CONSTRUCTION OF A LOCK AND DAM ON ROUGH RIVER, KENTUCKY, ON ROCK FOUNDATION, LOCK 178 FEET OVER ALL, DAM 150 FEET LONG.

Removing ruins of old lock and dam, 2,412 cubic yards of material, at $1 per cubic yard	$2,412 00
Excavation for lock 5,664, abutment 788=6,452 cubic yards, at 25 cents	1,613 00
Coffer-dam around lock-site	3,925 00
2,766 cubic yards stone masonry in lock, at $10 per cubic yard	27,660 00
Dam 150 by 32 by 14.5 feet	3,855 00
Timber and stone abutment, 60 feet long; counterfort, 130	4,653 00
Four gates, at $500	2,000 00
	46,118 00
Engineering and contingencies, 10 per cent	4,611 80
Total	50,729 80

ESTIMATE FOR THE CONSTRUCTION OF A LOCK AND DAM ON ROUGH RIVER, KENTUCKY, ON PILE AND TIMBER FOUNDATIONS, LOCK 178 FEET OVER ALL, DAM 150 FEET LONG.

Removing old lock and dam, 2,412 cubic yards, at $1	$2,412 00
Excavation for lock 5,664 and abutment 788=6,452 cubic yards, at 25 cents	1,613 00
Piling and grillage under lock	20,116 00
Piling and grillage under dam	3,605 00
Piling and grillage under abutment	1,105 00
Coffer-dam around lock-site	3,925 00
3,032 cubic yards stone masonry in lock, at $10	30,320 00
Dam 150 × 32 × 14.5 feet	3,855 00
Timber and stone abutment 60 feet long, counterfort 130 feet	4,653 00
Four gates	2,000 00
	73,604 00
Engineering and contingencies, 10 per cent	7,360 40
Total	80,964 40

ESTIMATE FOR REMOVING OBSTRUCTIONS TO NAVIGATION IN ROUGH RIVER, KENTUCKY, FROM ITS MOUTH TO HARTFORD, OR FOR A DISTANCE OF 30 MILES UP.

For deadening and removing the overhanging trees and snags projecting from the banks, and for removing snags from the bed of the river for a distance of 30 miles from the mouth up, at $200 per mile	$6,000 00

COMMUNICATION OF JUDGE A. B. BAIRD.

When we come to estimate the amount of commerce that would be subject to the Rough River, we can at best but make an estimate.

The distance in a straight line from the mouth of the river to the Falls of Rough is well known by all the residents of the Rough River section to be at least 40 miles; that a breadth of country on the north side of the river 10 miles in width, the products of which would find an outlet would be readily assented to by all; this would make 400 square miles. On the south side of the river, on an average of 5 miles, would increase the square miles 200, thus making the country tributary to the commerce of the river 600 square miles.

Besides this, that portion of the country around the falls east and north and southeast would add at least another 100 square miles at a very low estimate. Thus we have 700 square miles of rich agricultural lands, yet sparsely settled when compared with the large population it would sustain, and clothed with a fine growth of the very best quality of timber, consisting of all the varieties of the oak, poplar, and, towards the upper part of the stream, cedar, besides all along the whole length, for more than 80 miles by the meanders, sweet gum, beech, locust, black walnut, ash, hickory, and large sassafras, besides other kinds of wood and timber.

Building stone, both lime and sandstone, is abundant, with bituminous coal along three-fourths of its course. What may be the future possibilities of the latter as to what it will add to the carrying trade of the river it is now impossible to state. The lumber trade, both in the log and sawed, is immense, and has to be carried on only in four months of the year, and it is confidently believed by those well posted in the lumber trade that with constant navigation the year around the lumber business would double its annual magnitude.

In a conversation the writer had a few days ago with Col. W. H. Moore, of Hartford, who has been extensively engaged in the lumber trade for several years past, he gave it as his decided opinion that the annual run of logs out of the Rough River and its tributaries was fully 25,000 logs per year that would average 400 feet to the log, thus making of lumber in the log per year of 10,000,000 feet, worth, on an average, at least $15 per M., aggregating the vast sum of $150,000, and that half that amount was shipped out in sawed lumber, making the sum $225,000 per annum.

He stated further that with the river made navigable the year around, he fully believed that the quantity of timber made would be doubled.

The agricultural products of 700 square miles would seek an outlet by the river. Of these products tobacco is the largest, and putting the production of that article at the very low average of 7 hogsheads to the square mile, would give, say, 5,000 hogsheads of tobacco, worth on an average $150 per hogshead, we have the value of the tobacco crop that would go out of the river annually, the vast sum of $750,000.

Add to these articles wheat, corn, oats, potatoes, eggs, &c., these would make of themselves a large sum, but as we have no data to estimate these articles, as they, for want of transportation, have not been raised beyond family consumption. But it is confidently asserted that as soon as the means of a market were at hand a large trade in these articles would follow.

The incoming commerce of the country has been alluded to, and when we come to estimate the value of it and add it to the outgoing trade we have an amount vastly over a million of dollars.

One point, Hartford, on said river, of 1,000 inhabitants, pays an annual freight on incoming trade of nearly $20,000. There are many other points where incoming trade is distributed, though none of them as large as Hartford, yet in the aggregate they would amount to much more.

An allusion has heretofore been made to the possibilities of the coal that would move on this river if once made navigable. The allusion made of coal is also true of iron, as many large deposits are known to outcrop near the river, and no doubt would be profitably worked if reliable transportation was provided. Lead with a percentage of silver in it has also been found near the river.

What we have now partially developed is but an earnest, vastly to be multiplied by the improved navigation of the Rough River. Capital and labor will find a reward which has heretofore been denied to both.

Respectfully, but hastily, submitted.

A. B. BAIRD.

We have just read the paper prepared by Judge A. B. Baird, and heartily indorse all he has written.

Signed by S. W. Anderson and 42 others.

LETTER FROM THE GREEN AND BARREN RIVER NAVIGATION COMPANY.

GREEN AND BARREN RIVER NAVIGATION COMPANY,
Bowling Green, Ky., April 2, 1884.

Your letter of the 31st ultimo is at hand. In reply would say this company has never exercised any control over the tributaries of Green and Barren rivers, and although our charter may give us such right, I will say that we relinquish and surrender all such rights and privileges to any company who may want to improve these tributaries, knowing that the increase in our business on the main rivers will amply compensate us for such surrender.

Will aid and assist you in any way we can. Would like to see a regular Rough River packet from Hartford to Livermore.

Yours, truly,

JOHN A. ROBINSON.

A. B. BAIRD AND OTHERS.

AN ACT to grant the consent of the State of Kentucky to the acquisition by the United States of certain lands bordering on Rough River in said State, for the purpose of constructing canals, or erecting thereon dams, abutments, locks, lock-keeper's dwellings, offices, and all necessary structures for the construction and maintenance of slackwater navigation on said river, and ceding jurisdiction over the same, and for imposing fines and penalties for willful injuries to the grounds, buildings, and appurtenances acquired under the provisions of this act.

Be it enacted by the general assembly of the Commonwealth of Kentucky, SEC. 1. That whenever the United States shall make an appropriation, and shall be about to begin the improvement of Rough River, within the State of Kentucky, by means of locks and permanent or movable dam or dams with adjustable chutes, or by means of a canal, or any suitable structure to procure an easy and safe passage of boats, then the consent of the State of Kentucky is hereby given to the acquisition by the United States, by purchase or by condemnation, of any lands, buildings, or other property necessary for the purpose of erecting thereon dams, abutments, locks, lock-keeper's dwellings, chutes, and other necessary structures for the construction and maintenance of slackwater navigation on said river, or for the purpose of constructing canals on the same, and the said United States shall have, hold, use, and occupy the said land or lands, buildings or other property when purchased or acquired, as provided for by this act, and shall exercise jurisdiction and control over the same.

SEC. 2. *Be it further enacted*, That in case of failure of the United States to agree with the owners of any such lands as the United States may deem necessary for the purposes named in the first section of this act, it shall be lawful for the United States to apply for the condemnation of such land by petition to any judge of a court of record in or nearest to the county where the land may be situated, either in term time or in vacation, notice of the time and place of such application having been first duly given by publication for thirty days prior to the day of such application in some newspaper of general circulation, published in the county where the land lies, or if the owner or owners reside in the State of Kentucky, by personal service upon the owner or owners of such land at least twenty days prior to such application, and thereupon it shall be lawful for such judge to appoint three disinterested freeholders of the county where such land lies as commissioners, and having been first duly sworn to well and duly appraise the damages due the owner or owners of said land proposed to be taken, shall report in writing to the said judge the amount of damages to be paid to the owner or owners of such land, which report, upon confirmation by said judge, shall be held as final and binding upon said owner or owners of said land; and upon the amount of such damages being paid to the owner or owners of said land, the title of such land shall vest in the United States, and said land shall be exempt from all taxes and assessments so long as it shall remain the property of the United States.

SEC. 3. *And be it further enacted*, That if any person or persons shall willfully or maliciously injure any of the lands, buildings, or other property acquired or held under the provisions of this act, such person or persons shall be liable to a fine of not less than twenty dollars, and to an imprisonment not exceeding six months, or both or either, at the discretion of the court, said offense to be prosecuted in any court of competent jurisdiction.

SEC. 4. This act shall take effect from and after its passage.

Approved April 22, 1884.

AN ACT to change the name of Rough Creek, in Ohio, Grayson, and other counties, to that of Rough River.

Be it enacted by the general assembly of the Commonwealth of Kentucky, SEC. 1. That the name of Rough Creek, in Ohio, Grayson, and other counties, is hereby changed to that of Rough River.

SEC. 2. All acts in conflict with this act are hereby repealed.

SEC. 3. This act shall be in force from and after its passage.

Approved April 22, 1884.

AN ACT to vacate and annul an act entitled "An act to incorporate the Rough Creek Navigation and Manufacturing Company," approved March eighth, eighteen hundred and fifty-six, and the several amendments thereto.

Be it enacted by the general assembly of the Commonwealth of Kentucky, SEC. 1. That whereas the Rough Creek Navigation and Manufacturing Company was incorporated by an act of the general assembly, approved March eighth, eighteen hundred and fifty-six, and whereas the organization perfected under said act has ceased to exist, and all the rights, powers, and privileges created, authorized, and vested in said company by the terms and stipulations of said act have been abandoned for fifteen years last past; therefore, be it enacted, that all the rights, powers, and privileges authorized and conferred in said act, and the several amendments thereto be, and hereby are, canceled, vacated, and annulled.

SEC. 2. This act shall be in force from its passage.

Approved May 12, 1884.

E E 9.

REPORT UPON THE CONDITION OF THE GREEN AND BARREN RIVERS, KENTUCKY.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, January 27, 1885.

GENERAL: The river and harbor act of July 5, 1884, contained the following paragraph, viz:

> The Secretary of War is hereby directed to report to Congress at its next session, or sooner, if practicable, the condition of the Green and Barren rivers, * * * and the provisions and estimates of cost necessary to relieve the same from incumbrance, with a view to such legislation as will render the same free to commerce at the earliest practicable period.

The work of ascertaining the necessary information having been assigned to me, I have the honor to submit the following report:

The Green and Barren rivers lie wholly within the State of Kentucky, and with their tributaries drain an area of about 10,000 square miles, nearly all of which is contained within the State. Their general direction is northwest, and the Green, after receiving the waters of the Barren River, empties into the Ohio, about 8 miles above Evansville, Ind.

About fifty years ago the State of Kentucky undertook the improvement of these rivers by locks and dams. Six locks and dams upon the Green River, and one upon the Barren, were placed under contract. Of these, four locks and dams upon the Green, and the one upon the Barren, were completed, and the slackwater system, as it now exists, was opened to navigation in 1841. The two additional locks and dams upon the Green River were not constructed.

The first lock and dam on the Green River was placed at Spottsville, 8¼ miles from the Ohio; the second at Rumsey, 51¾ miles from the first; the third at Rochester, 43½ miles from the second; and the fourth at Woodbury, 41½ miles from the third. No. 1, Barren River, is at Green Castle, 15 miles from No. 4, Green River.

These five locks and dams, together with the backwater from the Ohio, give continuous navigation for a draught of 4 feet from the Ohio River to Bowling Green, a distance of 175 miles. They are owned by the State of Kentucky, and were operated by the State until 1868.

In 1868 the Green and Barren Navigation Company was chartered by the legislature of Kentucky, and the locks and dams were transferred to its control for a period of thirty years. A copy of the act granting the charter is inclosed herewith as Appendix A. It is stated in the preamble as a reason for this transfer that the works were largely in debt, and that they had been a constant source of expense to the State. This has been denied by those who opposed the charter. An interesting discussion of this subject may be found in the report of Maj. W. E. Merrill, Corps of Engineers (Report of Chief of Engineers for 1880, page 1824).

Under the arrangement made, the Green and Barren Navigation Company became the practical owners of the property belonging to the State of Kentucky upon these rivers. This property consisted of the locks and dams, and the land adjacent thereto, with the buildings and the water-power resulting from the dams.

The act regulated the toll on passenger and freight steamboats, which was to be computed by their full or deck tonnage, according to the custom-house rules, as follows:

Per ton at the lower lock (Spottsville)	$0 50
Per ton at the second lock (Rumsey)	30
Per ton at the third lock (Rochester)	20
Per ton at the fourth lock (Woodbury)	10
Per ton at the fifth lock (Green Castle)	10
Total per ton for one way	1 20

Or $2.40 per ton for round trip.

This, for a boat of 150 tons, whether loaded or light, would amount to $180 from the mouth of the river to Bowling Green, and for a round trip $360. The company was also authorized to collect a toll upon each passenger. but the amount was not stated in the charter. At the present time the passenger charges upon the company's boats, including this toll, vary from 3 cents to about 10 cents per mile, according to the distance traveled.

PRESENT CONDITION OF THE RIVERS.

The navigation of the Green and Barren rivers, as far as the slackwater system extends, is in good condition. The locks are serviceable, and are built of coursed masonry. All the land-walls, which were originally built too thin, have yielded, with exception of the one at No. 4 (Woodbury), to the pressure of the earth behind them. That of the lock at Rumsey leans more than a foot, and has been tied back with iron rods to a crib sunken in the earth in its rear, to prevent a continuance of the action and the wall from falling. It seems to be in a staple condition at present, but it is exceedingly doubtful how long it will remain so. A mill-race behind the land-wall at Woodbury prevents it from receiving as much pressure as the others.

The lower gates of all the locks are new, and are good and substantial. The upper gates are much older, and generally out of repair.

All the dams are wooden, and are composed of cribs filled with stone covered with sheeting. They are apparently strong and firm, and bear evidence of recent repairs.

The abutments of Nos. 1 and 2 are of masonry, and at No. 3, Green River, and No. 1, Barren River, are natural rock bluffs. That at No. 4 is composed of wooden cribs. The latter needs some repairs.

For additional details of the locks and dams attention is invited to the report of Mr. A. L. Duvall, who made the detailed examination of the works, and the survey of the lock-sites, which is herewith inclosed.

The pools of the dams are somewhat obstructed by snags and fallen trees, and although they are not sufficient in number to interfere with navigation during the day, they render running at night dangerous.

No examination was made of the rivers above the limit of slackwater navigation, as it was believed that the act of Congress referred alone to the portion were the incumbrance imposed upon commerce by the Green and Barren Navigation Company exists. The condition of the upper rivers was stated fully in the report of Major Merrill, heretofore referred to, and it is not probable that much change, if any, has taken place since that time.

CONDITION NECESSARY FOR FREE COMMERCE.

As these rivers are controlled by the Green and Barren Navigation Company, whose charter extends to March 9, 1898, a little more than thirteen years from the present time, it was necessary, in order to comply with the second portion of the act of Congress before quoted, which refers to the provisions and cost necessary to render these rivers free to commerce, to ascertain if the company would release its control of these rivers, and upon what terms it could be effected. Accordingly a letter for this purpose was addressed to the president of the company, in which a statement of the yearly amount of commerce upon these rivers was also requested.

In reply, the letters forwarded with this report as Appendix B were received.

In these it is stated that for the sum of $400,000 the company will transfer to the Government its rights and privileges to collect tolls, and will convey whatever claims it may have in the property acquired by its charter from the State of Kentucky, giving the United States free and unrestricted control of all the locks and dams upon the Green and Barren rivers. The company claims to have expended at least $300,000 in making the necessary repairs to the locks and dams to put them in working order and to preserve them in their present condition. It is also stated that the company's boats, which are the only ones plying these rivers regularly, carry yearly about 50,000 tons of freight, which is estimated to be four-fifths of the commerce upon the rivers. According to the statement made, the company receives about $10,000 annually for tolls upon the remaining one-fifth. Assuming that the other four-fifths pay toll in the same proportion, it results in a total tax of $50,000 upon the present commerce of these rivers, or estimating the total valuation of the commerce at $6,000,000, as suggested in the letter of the president of the company, it is a tax of five-sixths of 1 per cent. upon the value of every article passing through the locks.

This statement is sufficient to clearly show the restrictions which are imposed upon commerce in this locality, and to fully account for its slow development. The resources of the valley drained by the Green and Barren rivers are very great. It abounds in timber, coal, and iron, besides being in great part a rich agricultural country. Should the United States purchase the rights of the navigation company, these interests with free locks would undoubtedly receive a great impetus, and would rapidly develop into large proportions.

In determining whether the valuation, $400,000, placed by the Green and Barren Navigation Company upon their right to collect tolls, &c., upon these rivers is too great, it has been thought best to establish a comparison between that sum and the probable amount that the charter will net the company during the thirteen years before its expiration.

Assuming the receipts from tolls, &c., to be $50,000, as before stated, and the expenses of operating and making repairs to be 12,000 annually, the net receipts of the company will be $38,000 a year. The question then becomes, What is the present worth of an income of $38,000 a year, paid annually at a certain per cent.? This has been calculated by the ordinary formula for annuities, at compound interest, and the results are as follows, viz:

At 6 per cent	$336,401 84
At 5 per cent	356,955 66
At 4 per cent	379,454 70
At 3 per cent	404,128 48

In estimating the annual expenses likely to be incurred, the present condition of the works has been considered.

To give an idea of the expenses of similar works upon another river, a table has been compiled from the reports of the Monongahela Navigation Company, giving the annual cost for eleven years of the operating expenses and repairs upon the eight locks and six dams upon the Monongahela River. It is as follows:

Statement of cost of expenses and repairs made by the Monongahela Navigation Company upon eight locks and six dams in operation upon the Monongahela River.

Years.	Expenses.	Repairs.	Total.	Remarks.
1872	$31,317 66	$22,408 92	$53,756 58	
1873	36,424 41	46,958 15	83,382 56	One dam seriously damaged by ice.
1874	......	......	......	Report could not be obtained.
1875	35,617 62	44,870 20	80,487 82	Two dams damaged by ice.
1876	32,684 57	22,873 13	55,557 70	
1877	35,588 73	35,360 39	70,949 12	One lock damaged by ice.
1878	35,534 61	25,966 68	61,501 29	
1879	32,745 68	27,102 59	59,848 27	
1880	35,146 12	24,438 89	59,585 01	
1881	38,305 33	79,569 44	117,874 77	Two dams seriously damaged by ice.
1882	46,036 38	34,498 56	80,534 94	
1883	41,864 50	44,409 62	86,274 12	Leak in lock wall.
Total for 11 years	401,265 61	408,456 57	809,722 18	
Average per year	36,478 69	37,132 41	73,611 11	

The average cost of maintaining these works is thus seen to be greatly in excess of the amount allowed for expenses and repairs upon those of the Green and Barren Navigation Company. It should be observed, however, that the business of the Monongahela Navigation Company is much greater than that of the Green and Barren Navigation Company, which causes greater cost for service, and also that the locks and dams of the former are often greatly injured by ice, from which those of the latter are comparatively free, as the occurrence of heavy ice in the Green and Barren Rivers is exceptional.

It must be borne in mind, even should the United States purchase the interest of the Green and Barren Navigation Company in the locks and dams, that, under the charter, all the property would revert in thirteen years to the control of the State of Kentucky, who merely leased them to the Company. If it should be contemplated by Congress to make the purchase, I would suggest before any appropriation be made available for this purpose that the State of Kentucky be asked to cede to the United States all the locks and dams, lands and buildings in question, so that when the purchase is made the title to them would be vested in the United States.

This report is accompanied by five maps* showing the general location of the locks and dams and five detailed maps of the works.

Very respectfully, your obedient servant,

JAS. C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

APPENDIX A.

AN ACT to incorporate the Green and Barren River Navigation Company.

Whereas the Green and Barren River line of navigation has always been a charge upon the State, and is now largely in debt and without prospect of any better condition; and whereas it is of great importance to the country to keep said line in working order, and at the same time avoid any public expense, if possible, and believing that object can be accomplished by letting it to an incorporated company: Therefore,

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* Omitted.

Be it enacted by the general assembly of the Commonwealth of Kentucky:

(1) That J. A. Robinson, J. V. Sprowle, W. S. Vanmeter, C. J. Vanmeter, E. B. Seeley, H. C. Murrell, William Brown, D. C. Turner, C. J. Smallhouse, and their associates and successors, be, and they are hereby, created a body corporate with the name and style of the Green and Barren River Navigation Company, and shall have perpetual succession during the term of thirty years, and in that name may sue and be sued, make contracts, and transact all their legitimate business as a corporation; may use and change their common seal and make suitable by-laws for the regulation of the affairs of the company, and to regulate their elections to fill offices, vacancies, and in all things not inconsistent with the laws of the land.

(2) That the said Green and Barren River line of navigation and their tributaries, together with the grounds, houses, water-works, rents, profits, tools machinery, implements, and appurtenances, and all the franchises thereunto belonging or appertaining, be, and the same are hereby, loaned and conveyed unto the corporators named in the first section of this act, and to their associates, successors, executors, heirs, and assigns, for and during the term of thirty years from and after the time they get possession thereof; and it shall be the duty of the govenor of this Commonwealth to cause possession thereof to be delivered unto them as soon after the passage of this act as they or any of them who may choose to accept may give notice of readiness to receive it upon their complying with all the conditions precedent herein provided.

(3) The business of the company may be to use and suffer to be used said line of navigation for all purposes of navigation, and also the water power, property, rights, appurtenances, and all the franchises thereunto belonging, as they may direct, not inconsistent with the purposes of said line as expressed by law; and as an auxiliary to said business and to facilitate commerce and trade, and to develop the resources of wealth along said line, it may also be their besiness to open and work coal mines and other mines and to deal in the products thereof, as also in the products of the country and other things, as well as in the work of machinery and navigation on said line. They may also lease, buy, sell, hold, and otherwise acquire and dispose of any real and personal estate, by any manner not prohibited by law, the same as a natural person, and may do all necessary or advantageous acts in the same way in the transaction of their business, not inconsistent with the constitution of this State or of the United States.

(4) It shall be the business and duty of said company to use due diligence in keeping up said line of navigation in good repair, and to return it and all its appurtenances at the expiration of the lease in good condition as at present, or unless prevented from so doing by unavoidable causes, and to hold the State harmless in the premises, and to pass and permit all boats, crafts, and other things to navigate said rivers, according to certain specified rates herein prescribed as tolls, which shall inure to said company.

(5) (Organization, &c., of company) * * * and a prior lien is hereby retained by the Commonwealth against all the property, rights, and franchises of said company, as security to said Commonwealth for the faithful performance of all the duties herein imposed upon said company; and no individual of said company shall be bound for said company beyond the interest he may have therein.

(6) All tolls shall inure to the company, and the rate of toll on passenger and freight steamboats, and other boats carrying freight other than coal or stone, shall be regulated by their full hull or deck tonnage, according to the custom-house rules as to the management of tonnage: *Provided*, That the rate of toll for such boats passing such locks shall not exceed per ton, measured as aforesaid, fifty cents at the first lower lock, and thirty cents at the second, and twenty cents at the third, and ten cents each at the two other upper locks, and the same for returning; and for each passenger, and for all other boats, barges, skiffs, and other water crafts, loaded and empty, including rafts and other things passing said rivers, they may establish tolls from time to time not exceeding the present rates established by the board of internal improvement as applicable to the Kentucky, Green, and Barren river lines of navigation at this time.

(7) (Transfers of interest, &c.)

(8) (Liabilities for damages.)

(9) (Steamboats, rafts, &c., shall obey company's rules.)

(10) (Penalty for willful injury of works.)

(11) It shall be the duty of the company, or such of them as may choose to accept the provisions of this charter, together with their associates whom they may choose to associate with them, to execute their bond to the Commonwealth of Kentucky, with security, the solvency of which to be approved by the governor of said Commonwealth, and be attested by him under the seal of his office, which bond shall be in duplicate, one copy to be retained by the State and the other by the company. The conditions of the bond shall be as follows: "In consideration of the undisturbed possession of the Green and Barren River line of navigation and its tributaries, to-

gether with its grounds, houses, water-powers, rents, profits, tools, machinery, implements, appurtenances, and all its franchises thereunto belonging or appertaining, now to be delivered to us, the undersigned, to hold for thirty years, under an act of the legislature incorporating the Green and Barren River Navigation Company, we accept the same, and as a company aforesaid are bound hereby in the penal sum of $500,000 to perform the duties and obligations imposed by said act of the legislature, and to return the same in good order, as set out in said act, subject to the conditions therein expressed. Given under our hands and corporate seal of said company this —— day of ———, 18—." Which bond being executed by the parties aforesaid, and approved as aforesaid, and attested by the governor, shall entitle the company and their associates to all the rights conferred by this act: *Provided, however*, That said company may associate others with them before or after the execution of said bond: *And provided further*, That the Commonwealth shall have a lien upon all property of said company to secure a compliance with the stipulations of said bond.

(12) This act to be in force from its passage.

Approved March 9, 1868.

AN ACT to amend and explain an act entitled "An act to incorporate the Green and Barren River Navigation Company," approved March 9, 1868.

Whereas an act entitled "An act to incorporate the Green and Barren River Navigation Company," approved March 9, 1868, authorizing said company to collect certain tolls from boats and other things navigating said rivers according to the rates established by the board of internal improvement, as then applied to the Kentucky, Green, and Barren river lines of navigation; and whereas the rates so established as applicable to the Kentucky River are not deemed applicable to Green and Barren rivers, and are misleading; and whereas complaints have been made that said company have violated the spirit of their charter by giving it a wrong construction, to the prejudice of the public, and in making changes not contemplated therein, and that are not authorized by law; and whereas it is clear that said company have vested rights under their said charter that cannot be impaired, but which may be confined to their just and legitimate limits: Therefore, to explain and limit the rights of said company in the protection of the public, while at the same time the vested rights of the said company must be respected:

It is now enacted by the general assembly of the Commonwealth of Kentucky:

SECTION 1. That the charges herein prescribed and limited may be charged by said company against boats, barges, and things navigating said line of navigation, and no greater charges therefor shall be made.

SEC. 2. That the rate of tolls authorized by said act to be charged against boats, according to the tonnage rule or principle, shall not apply to boats or things plying only between the dams; but all boats, barges, and other crafts plying only between the dams on slackwater in said line of navigation shall not be required to pay any other or greater tolls than such as were established by the board of internal improvement, and that were in force at the time of the passage of said act, and that were applicable alone to the Green and Barren river line of navigation, except as herein limited.

SEC. 3. No boat used exclusively in towing shall be required to pay tolls according to the rules of tonnage as claimed under said act. Such boats, in passing the locks and dams, shall only be required to pay two dollars therefor at each lock to said company.

SEC. 4. The charge of two dollars lockage claimed under said act shall not be paid on any raft of timber passing said locks and dams, but the charges shall be as fixed by the board of internal improvement, and it is as follows: For rafts fifteen feet wide and under, three cents per linear foot at each lock; over fifteen and under twenty feet wide, five cents per linear foot at each lock; rafts twenty feet wide and under thirty feet wide, six cents per linear foot at each lock; rafts thirty feet wide and under thirty-six feet wide, seven cents per linear foot at each lock.

SEC. 5. No flat-boat or barge starting from above the influence of slackwater shall be required to pay any tolls except for passing through a lock, and that shall not exceed the rates prescribed by law.

SEC. 6. No flat-boat or barge starting within the influence of slackwater shall be required to pay exceeding two dollars lockage and three cents per linear foot of each boat or barge at each lock; and the two dollars lockage herein authorized by this section shall not be chargeable unless the boat or barge actually passes through the lock.

SEC. 7. No flat-boat or barge loaded with coal or stone or sawed lumber shall be required to pay exceeding two dollars lockage and six cents per linear foot for such boat or barge at each lock, but the two dollars lockage shall not be chargeable unless the boat or barge actually passes through the lock.

SEC. 8. This act shall take effect and be in force from and after its passage.

Approved March 15, 1876.

[Acts of 1878, page 513, chapter 432.]

Be it enacted by the general assembly of the Commonwealth of Kentucky:

SECTION 1. That section 5 of an act entitled "An act to amend and explain an act entitled 'An act to incorporate the Green and Barren River Navigation Company,' approved March 9, 1868," approved March 15, 1876, be amended by inserting after the word "barge" the following: "Or rafts of logs or timber of any kind."

SEC. 2. That section 6 of said act be amended by adding, after the word "barge," whenever it occurs in said section, the following: "Or rafts of logs or other timber."

SEC. 3. This act shall be in effect from and after its passage.

Approved March 14, 1878.

REPORT OF MR. A. LESLIE DUVALL, ASSISTANT ENGINEER

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, January 21, 1885.

SIR: I have to submit the following report on surveys of the locks and dams on Green and Barren rivers, Kentucky, made in obedience to your orders.

I began the surveys November 28 and completed them December 20, 1884.

LOCK AND DAM NO. 1.

This lock is situated on the left or west side of Green River, at Spottsville, Henderson County, Kentucky, 8½ miles above its mouth and behind an island 1,225 feet long and 285 feet wide at its widest part. The lock is approached at each end by a narrow channel. At the upper end this channel is 820 feet long and from 65 to 73 feet wide, with a minimum depth of 5.5 feet in the middle. At the lower end the channel is 420 feet long, 52 feet wide, with minimum depth of water in the middle of 4.5 feet. These channels require frequent dredging to keep them to the required depth.

The dam at this place extends across the river from the outside of the island and has a masonry abutment at each end; the abutment on the island is connected with the eastern lock-wall by a wall across the island, joining the upper counter-fort of said wall with the upper counter-fort of the west abutment. These abutments and the wall across the island appear to be in good condition, with the exception that the coping and part of one course of masonry is gone from the east abutment, and on the west abutment there are two coping-stones loose, and one gone from the upper counter-fort. The abutments have a batter of 1 inch to 1 foot on their faces. Each of these butments was formerly occupied as a mill site, but nothing now remains of the mills but a few decayed timbers and some twisted and broken iron-work.

The dam is a timber crib filled with stone and covered with 6 inch sheeting, and slopes both ways from the crest at an angle of about 15 degrees; this dam leaks through the lower breast wall at various places along nearly the whole length of the dam; the back of the dam is protected by riprap.

The dam is not built on a straight line; it has an angle in it, the vertex pointing up-stream; the departure from a straight line at the apex is 24 feet.

The material of which the lock-walls and abutments are built is a yellowish-gray sandstone not very hard. The walls of this lock are 8 feet thick on top from the recess to the ends of the walls, and 4.5 feet on top at other portions, and 9 and 10 feet thick at bottom. The upper portion of these walls, from upper recesses to head of walls, is raised by two courses of masonry 2 feet 8 inches; on the other parts of the walls three courses of 12-inch timber are bolted to raise the walls.

Both of these walls lean in toward the lock-chamber, the west one 3¾ inches, and the east one, or one towards the island, 2¼ inches, making the width across top of lock-chamber, at middle, 35.5 feet, 6 inches less than its original width. There is one stone cracked, 70 feet from head of lock, fifth course from top of west wall; also two coping-stones cracked. The points of the quoins are badly broken in this lock and there is considerable leakage around the gates where these breaks occur. The ground behind the walls is paved, but the paving is broken and torn up in many places. The lift wall of this lock, as well as of all of them, is built of timber.

The lower gates are good, having been put in new during last fall, but they leak about the wickets, of which there are two in each gate, one near heel-post and one near toe-post. The upper gates are old gates cut off, and show signs of decay at mortises; they also leak very badly about the wickets, which are in the same relative positions as in the lower gates. There are also leaks through the sheeting of these gates.

The State of Kentucky owns 6.91 acres of ground on the west or Spottsville side, on which there are a small warehouse or tool-house and a lock-keeper's house, both frame; on the opposite side of the river the State owns 2 acres.

The highest water known here was February 19, 1884, when it reached a height of 51.78 feet above the lower miter-sill of Lock No. 1.

LOCK AND DAM NO. 2.

This lock is at Rumsey, McLean County, Kentucky, 60 miles above the mouth of the river.

This lock is approached from above by an artificial channel, 480 feet long, minimum width 55 feet, and depth 6 feet, formed by three guiding dikes and some dredged material thrown up and overgrown with willows.

A mill-race (20 feet wide near its mouth) passes around the lock, leaving the channel 15 feet above head wall of lock and entering again 320 feet below the lock.

The lower channel is 1,240 feet long, 80 feet wide, and has 5.5 to 6 feet of water; it is formed by dredged material principally, piled up and overgrown with willows; there were evidences of remains of guiding-dikes at the upper and lower ends of this channel.

Dam No. 2 seemed to be in good condition; there was 1.12 feet of water passing over it when I was there; it is built with an angle near the middle, the vertex pointing up-stream; the departure from a straight line is 13 feet. The general construction of this dam is the same as No. 1, only the slope of the overfall is greater, being 17° 30′.

The abutment on the west side of the river is 47 feet long, 4 feet wide on top, with counter-forts at upper and lower ends, running back 27.55 feet; the face of the abutment has a batter of 1 inch to 1 foot; the top of the abutment was 9.63 feet above the upper pool. There is a crack 1½ inches wide in the face of this abutment, beginning 14 feet from upper corner, at top, and extending down to surface of water over crest of dam, or 35 feet from upper end. There is a grist mill on this abutment, but not in operation; there is a saw-mill immediately behind it in operation. I was informed that the upper end of the river wall was formerly used as a mill site also.

Lock No. 2 is on the left side of the river, and was evidently built of same class of sandstone as No. 1, but of poorer quality.

The land wall is 7.9 feet thick on top, from recesses to ends of wall, and 3.84 feet thick between recesses; at the bottom it is 9 and 10 feet thick. This lock is in a very bad condition; the land wall leans in toward the lock-chamber 1.07 feet, at a point 90.33 feet from the upper end, forming a bulge or bow in said wall; there are three cracks in it between the recesses, two of them extending from top to bottom, and one extending down ten courses; these cracks vary in width from one half inch to 2 inches, and in places where the corners have been broken off they vary from 4 inches to 12 inches in width; the face of the wall is also scaled by the action of frost.

This wall is now partially supported by 13 plate washers or straps of iron, with 5 anchor ties of 1½ inch iron rods passing through each washer and the wall, and fastened in a crib filled with stone, built behind the land wall; counter-forts 4 feet on top extend back 30 feet from the face of the land wall at each end.

The river wall is 11.55 feet thick on top and has a batter of 1 inch to 1 foot on river face, the other face vertical; it does not lean but has several cracked courses on the inside near the middle and 16 leaks showing from the outside, ten of which show water spouting from fissures near the bottom, and six show water bubbling up at the side of the wall, indicating leaks under the wall. There are several holes in the outside of this wall, occurring at seams, which are from 6 inches to 3 feet in length, from 2 to 12 inches in width, and from 3 inches to 2 feet in depth. There is a crack on the inside, near the head, 1 inch wide, beginning three courses above upper pool and extending down.

The lower counter-fort has a crack 1¼ inches wide from top to bottom, beginning 10 feet back from face of land wall, and breaking courses to within 8 feet of face of said wall at bottom. A stream of water pours from the lower part of this crack when the lock is filled. There is an iron strap bolted on top of wall to keep the crack from increasing. The points of the quoins are badly broken, and there is considerable leakage around them. The lift wall in this lock is the same as in No. 1. The gates are about the same as in No. 1; lower ones new and upper ones old; all leak around wickets. There are 11.11 acres of property owned by the State on the Rumsey side, on which are situated a tool-house (frame), a lock-keeper's house (brick), and 2 mills (frame), 1 woolen mill, and 1 flouring mill. The State owns only the abutment on the opposite side. The highest water here, which occurred in February, 1884, was 39.40 feet above the lower miter-sill of this lock.

LOCK AND DAM NO. 3.

This lock is at Rochester, Butler County, Kentucky, 103¼ miles above the mouth of the river. It is on the right side of the river, just below an abrupt turn to the right of 100°, and below the mouth of Muddy River, which empties into the Green at Rochester.

The dam at this place seems to be tight and has had new sheeting put on recently. The end next to the abutment is 2.5 feet higher than the end at river wall. The general construction of this dam is the same as at Nos. 1 and 2. The slope of the overfall is 16°.

The abutment here is good and is a projecting ledge of natural sandstone.

This lock is built of gray sandstone, not very hard. The land wall is 9 feet thick on top, from recesses to ends of wall, and 4 feet on top between recesses. This wall is 12 feet thick at bottom. There are counter-forts at each end of the wall, 4 feet thick on top, extending 30 feet back from the face of land wall. The walls, from the upper recesses to heads of walls, are two courses of stone higher (2.54 feet) than the other parts of the walls, but the other parts have three courses of 12-inch timber bolted on top to raise them. The river wall is 12 feet thick on top and is vertical on both faces.

The land wall is bulged in slightly about the middle; there were no cracks visible on the face of the land wall.

The river wall has three cracks visible on the river face, extending from the surface of the lower pool nearly to the top, and the wall is slightly bulged between two of them, but there were not any leaks visible. There are several places on both walls where the face has peeled off from the action of frost. On the top at both ends the walls are battered and broken; the corners of the recesses and points of quoins are also broken in many places, but not as badly as at No. 2. There was a pavement for about 50 feet back of the land wall, but most of it has been torn up. The lift wall is the same as in Nos. 1 and 2. The gates of this lock are about the same as those of No. 1; lower ones new and good, upper ones old and poor; all leak around the wickets.

The State owns property on both sides of the river; on the east or lock side $2\frac{1}{100}$ acres, on which are a tool-house and lock-keeper's house, and on the west side $7\frac{18}{100}$ acres, on which are situated a saw-mill and a blacksmith's shop. All buildings are frame and in poor condition.

The highest water known here, which occurred in February, 1884, was 48 feet above the lower miter-sill of Lock No. 3.

LOCK AND DAM NO. 4.

This lock is at Woodbury, Butler County, Kentucky, on the left side of Green River, 145 miles above its mouth, and 2,600 feet below the mouth of Barren River.

This lock is approached from above by an artificial channel 250 feet long, about 60 feet minimum width, with 8 feet of water. This channel is formed by 5 guiding-dikes.

Dam No. 4 is good. It was rebuilt in 1880. It is on a curved line approximately, the middle ordinate of which is 13.15 feet. It is of the same class as the other dams already described. The angle or slope of the overfall is greater, being 20 degrees. The abutment for Dam No. 4 is a timber crib 118.2 feet long by 7.6 feet wide, filled with stone. It has a counter-fort 10 feet wide extending back from the upper end 51 feet and into a good bank. The upper end of the abutment where the counter-fort joins it was 11.4 feet above the surface of the upper pool. The timber in this abutment is decaying, and several of the cribs are not entirely filled with stone.

The walls of Lock No. 4 are of hard gray sandstone of excellent quality, and are in good condition generally, much better than any of the others. The land wall is 7.8 feet thick on top from recesses to ends of wall and 4 feet between recesses; 12 feet thick at bottom. The river wall is 12 feet wide on top, and both faces are vertical. These walls do not lean and are not cracked, and but few places at the corner of the recesses and the points of the quoins are broken.

The ground behind the land wall is paved, and 24 feet back from the face of said wall a mill-race runs to furnish power to two mills—one flour-mill and one saw-mill. Part of the saw-mill rests on the lower counter-fort of the land wall. The lift-wall is the same as in the other locks already described.

The gates are about the same as those already described, with the exception that the upper gates are a little worse than the upper ones in the other locks.

At this lock it is said that there is never less than 6 feet of water over the lower miter-sill. On the Woodbury or land wall side the State owns 8.61 acres of ground, on which are situated two mills and a tool-house (frame) and a lock-keeper's house, of brick. On the opposite site the State owns 1.66 acres.*

LOCK AND DAM NO. 5, OR NO. 1, BARREN RIVER.

Lock No. 5, or No. 1, is on the right side of Barren River, 14¼ miles above its mouth, and about one-fourth of a mile above Green Castle, Warren County, Kentucky, and is 160 miles above the mouth of Green River.

This lock is approached by artificial channels from above and below. The channel above is 140 feet long by 60 feet average width, with 8 feet of water; below it is 127.4 feet by 60 feet average width, and 7 feet of water. These channels are formed by two guiding-dikes above and two below the river wall of lock.

The dam appears good and has had new sheeting recently. It is on gravel, and has an angle near the middle with the vertex pointing up-stream. The departure from a straight line is 10.75 feet. This dam is of the same class as the other dams. The angle of the overfall is 15° 15′. The abutment here is a solid hard sandstone bluff, 15 feet above the surface of upper pool, to the first bench and a road in the face of the bluff. There is a flouring-mill 56 feet below the crest of the dam. The head race of this mill passes over the end of the dam in a timber flume to the mill.

The lock-walls are of hard gray sandstone of excellent quality.

The land wall is 8 feet thick on top from the recesses to the end of the wall and 4 feet between the recesses; it is 12 feet thick at bottom.

The counter-forts are 4 feet on top and extend 26 feet back from the face of land wall.

The lower end of the land wall has broken away from the lower counter-fort, in which there is a crack from top to bottom, and leans in toward the lock-chamber 6 inches. There are four iron straps bolted across the crack to keep it from increasing.

There is a pavement behind the land wall for about 30 feet back from its face.

The river wall is 12 feet wide on top, with both faces vertical. There are two small cracks in the inner face of this wall 70 and 80 feet from the lower end.

There is said to be a leak under the river wall 53 feet from the lower end, but it was not visible at time of survey, as the water was too high to see any indications of leakage. A spring is also said to bubble up under the lower end of this wall.

I was informed by Mr. David Stephens, who furnished stone for the lock when built and was a former lock-tender, that 106 feet of the lower end of this river wall was taken down and rebuilt on pile foundation in 1846 and 1847. There are but few places in these walls where the corners of the recesses or points of quoins are broken. The lift-wall is of timber, built similar to those in the other locks.

The gates are about the same as those at Nos. 1, 2, and 3, but there is not much leakage around the wickets or quoins.

The State owns 5$\frac{32}{100}$ acres of ground on the lock side, on which is a tool-house near the lock, and a lock-keeper's house with necessary outhouses 700 feet back from the lock. All buildings are frame.

The State does not own any property on the opposite side of the river.

The highest water known here occurred in February, 1884, and was 47.42 feet above the lower miter-sill of this lock.

I append hereto a tabular statement of the localities and principal measurements of the five locks and dams described above.

Very respectfully, your obedient servant,

A. LESLIE DUVALL,
Assistant Engineer.

Capt. JAS. C. POST,
Corps of Engineers, U. S. A.

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* The highest water ever known at this point occurred in February, 1884, and was 50¼ feet above the lower miter-sill of the lock.

Locality and principal dimensions of locks and dams on Green and Barren rivers, Kentucky.

Items.	Locality.				
	No. 1.—On left side of Green River, at Spottsville, Henderson County, Kentucky, behind island.*	No. 2.—On left side of Green River, at Rumsey, McLean County, Kentucky.†	No. 3.—On right side of Green River, at Rochester, Butler County, Kentucky.‡	No. 4.—On left side of Green River, at Woodbury, Butler County, Kentucky, 2,600 feet below mouth of Barren River.§	No. 5 or 1.—On right side of Barren River, about quarter of a mile above Green Castle, Warren County, Kentucky.‖
Locks:					
Distance above mouth of Green River, miles	8½	60	103½	145	160
Length over all ....feet	214. 28	214. 75	214. 80	214. 61	214. 52
Original width ....do..	36	36	36	36	36
Least present width ....do	35. 50	34. 93	35. 80	36	35. 50
Distance between hollow quoins....do..	161	161. 65	161. 53	161. 67	161. 75
Least water over lower miter-sill... do..	4	4	4	6	4
Lift....do..	17. 11	14. 04	18. 41	15. 59	15. 95
Height of walls above lower miter-sill, feet	29. 60	26. 50	29. 56	30. 50	30. 10
Height of timber addition on top of walls above lower miter-sill ....feet.	32. 80	None.	32. 76	None.	None.
Height of crest of dam above lower miter-sill ....feet.	21. 11	18. 04	22. 41	21. 59	19. 95
Base ....do..	46. 5	37	55	50	80
Length ....do..	529	675. 6	334. 5	379. 7	283. 3

* Rock foundations.
† Slate rock foundation.
‡ Sandstone foundation.
§ Lock and half of dam on rock foundation; balance on gravel and piling.
‖ On gravel and timber.

APPENDIX B.

LETTERS FROM THE PRESIDENT OF THE GREEN AND BARREN RIVERS NAVIGATION COMPANY.

I.

BOWLING GREEN, KY., *November* 27, 1884.

DEAR SIR: Your favor of October 21 came duly to hand. My reply has been delayed longer than I wished, owing to inability on the part of our superintendent to sooner collate data from which I could intelligently supply you with the information desired. In replying to your series of interrogatories, I shall reserve until the last my answer to your first question. Noting your second question, I have to say: The commerce upon the Green and Barren rivers for the past year includes a vast amount that was not controlled by our line. I cannot, therefore, furnish you with anything like an accurate estimate of the volume of business carried on on these waters. Speaking for our line, and relying upon carefully prepared statistics furnished by our superintendent, I place the amount of freight carried on our steamers during the twelve months ending 30th instant at 50,000 tons, exclusive of the transportation of coal from the mines along Green River to points touched by our steamers. The extent of this coal business is assuming large dimensions, and will perhaps aggregate three-quarters of a million bushels, over a half million bushels being delivered at the port of Bowling Green alone. This branch of our company's business is deserving of especial mention in your report upon the resources of Green and Barren rivers. When the mining interests along these rivers shall have been fully developed, I predict that no portion of the Commonwealth will exceed this in point of solid wealth, and I believe that once under the control of the General Government, with free locks, the wealth of this section would be rapidly developed. Our company is laboring to the extent of its ability to accomplish that end and encourages others to do so, but with a limited capital and heavy expense in maintaining navigation it is not presumed that we can accomplish what we desire to see along these rivers. Another source of great wealth along Green and Barren rivers and their tributaries is the almost inexhaustible supply of valuable timber.

The marketing of logs and the various timber products furnishes employment to a large number of laborers, and results in furnishing capital a profitable return on investment. This business, already large, is susceptible of being very greatly increased in volume, and if developed to the extent possible to secure it, would add largely to the carrying trade of the rivers and to the wealth of those engaged in the business. With all these varying interests being developed, and having no means of acquiring information concerning the amount of business done by others than our own company, I can give you no estimate that would enable you to form a correct idea of the value of Green and Barren rivers as navigable streams. You can see at once that the resources along their waters are very great and the amount of carrying trade susceptible of being developed very large.

When our company obtained its charter from the State of Kentucky the rivers named in the charter over which we assumed control were in a very bad condition; even worse, if possible, than was the Kentucky River when it passed under the control of the National Government; that is to say, all the locks and dams were, in a manner, gone to ruin; parts of several dams had washed out, and *all* had to be rebuilt. Indeed, the cost to our company to rebuild the old work was almost as great as it would have been to erect entirely new ones, the cost so far exceeding $300,000.

We now have the locks and dams in good condition; in fact, we think that they will require very small additional expense during the fourteen years yet remaining to us under our charter. Considering this fact, and the further one that the carrying trade of our line is rapidly increasing, we regard our franchise as more valuable to us now than at any time since the State gave us control of the rivers. We anticipate larger profits and smaller outlay than during the past years of our existence as a corporation. If the United States should assume control of these rivers the Government will come into possession of a valuable property, requiring not a tithe of the appropriations bestowed upon lines of less importance to keep it in good repair and render the Green and Barren rivers free navigable streams, thus going far to develop a very wealthy section of country.

In conclusion, after reciting all the foregoing facts, it is the opinion of our company that the franchise bestowed upon us by the State of Kentucky is worth to us, at a low estimate, $400,000, and for that sum we will part with it and transfer all our rights and privileges to collect tolls to the United States.

In submitting your final report to the Secretary of War, should you deem it advisable to recommend the transfer of these rivers to the control of the General Government, I wish to assure you that any information in the power of this company to give will be cheerfully communicated to the proper authorities; and should you require additional data to enable you to complete your report, you have but to intimate to me your desires, and I will gladly comply with your request, if in my power.

Very respectfully, your obedient servant,

C. G. SMALLHOUSE,
President.

Capt. JAMES C. POST.
United States Engineers.

II.

BOWLING GREEN, KY., *January* 2, 1885.

DEAR SIR: I am in receipt of your letter of 31st ultimo, in which you ask for a more explicit statement of the proposition made by me in a former letter of this company to transfer to the General Government the rights granted to it by the State of Kentucky to charge tolls for the navigation of Green and Barren rivers. The proposition made by me was intended not only to convey the right to collect tolls, but also whatever claims this company might have by reason of its charter upon any of the property conveyed to it by State authority in granting the franchise. To be explicit: For the sum of $400,000 this company will transfer to the United States all its rights and privileges to collect tolls upon Green and Barren rivers, and will convey whatever claim it may have in the property acquired by its charter from the State to the General Government, so that in so far as this company is concerned the United States shall have entire control of the locks and dams on said rivers, together with the lands and lock-houses belonging to the State of Kentucky, and all other property necessarily belonging to and constituting a part of the property conveyed to this company by the State. In this connection permit me to call your attention again to the fact that at the time this company assumed control of these rivers the locks and dams were in very bad condition, and that an expenditure almost equal to the amount now asked of the United States has been necessary to place the rivers in the condition you have recently found them. In reply to your inquiry, "What structures, if any, have been erected by private individuals or companies upon the lands of the State, &c.:" At Brown's Lock there is a flouring-mill; at Woodbury, a saw-mill, grist-mill, and carding-machine; at Calhoun, a flouring and saw-mill; and on the Rumsey side, at the same locks, is a flouring-mill and woolen-mill. All these structures are erected upon lands belonging to the State and adjoining the locks and dams.

The leases were originally given by the State, and were continued by this company when it assumed control, and have until the expiration of time named in our charter to run; the leases also embrace water-power. No other structures have been erected by private individuals or corporations, and no other leases for water-power at the several dams exist. Of course, all rents accruing from those named would inure to the benefit of the United States should the Government assume control of the rivers.

As to the value of commerce on these rivers, I can only give an estimate based upon the business of this company. During the year 1883 there was received in tolls $11,955.21, and for the first nine months in 1884 $7,897.76 for vessels other than those belonging to this company. We estimate the business done by this company to be about four-fifths of the commerce of the rivers. Our boats carry in the neighborhood of 50,000 tons of freight annually. The coal output will aggregate 70,000 tons, and the lumber interest will approximate 200,000,000 feet, counting the sawed lumber and logs rafted out of the river. It is estimated that 6,000 hogsheads of tobacco are shipped to market from counties adjacent to the rivers, and depending upon them for transportation facilities. With a large trade in staves, hoop-poles, tan-bark, and stone added to the figures I have given, I would estimate the total value of the commerce of Green and Barren rivers per annum at about $6,000,000; more probably above than below that amount. This does not represent the resources of the section of country to be benefited. The one item of coal, with a present output of 70,000 tons, could be increased sevenfold, and the timber product is inexhaustible. In the counties adjacent to this line of navigation it is safe to assert 50,000,000 pounds of tobacco are annually grown, and fully one-half of that amount would go to market by way of these rivers were they made free, and thus afford cheaper transportation. Estimating our receipts from tolls at $10,000 annually, and supposing that to represent one-fifth of the tonnage passing through the locks, our own vessels constituting four-fifths, it will be seen that lockage fees alone constitute a tax of $50,000 per annum upon the commerce of the rivers. Indeed, upon a careful estimate, the lockage upon our own boats and barges last year, if compelled to pay at schedule rates, would amount to $51,000. Of course there is a great deal of stuff passes our locks over the dams in high water, upon which we collect no tolls and is not included in the estimate I have given you. This estimate is based upon such data as I have at command, and while possibly not accurate, yet may serve to afford you an idea of the value of these rivers as navigable waters. If you should desire more specific information, I do not know from what source it can be procured. I believe my figures will approximate the true values.

Would it be asking too much to request you to advise me at what time your report will be submitted to the Secretary of War?

I am, very respectfully, &c.,

C. G. SMALLHOUSE,
President.

Capt. JAMES C. POST,
United States Engineers.

APPENDIX F F.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

1. Bridge across Detroit River between Belle Isle and the American shore.
2. Bridge across Willamette River at Portland, Oregon.
3. Bridge across the Monongahela River, near Fairmont, West Virginia.
4. Bridge of the Northern Pacific Railroad Company across Saint Louis River, Minnesota and Wisconsin.

F F 1.

PROPOSED BRIDGE ACROSS THE DETROIT RIVER BETWEEN BELLE ISLE AND THE AMERICAN SHORE.

CITY OF DETROIT, CITY ATTORNEY'S OFFICE,
Detroit, May 27, 1885.

DEAR SIR: At the request of the municipal authorities of this city I would respectfully ask for information as to the right of this city to construct a bridge over a branch of the Detroit River between Belle Isle and the American shore. As will be observed by the maps, Belle Isle is situated at the mouth of Lake Saint Clair, near the head of the Detroit River, and constitutes about 700 acres of land, which is now owned and maintained by the city of Detroit as a park. The main channel of the Detroit River runs south of this island, between it and the Canadian shore, and all navigation passes through the main channel. The American channel lies between the island and the American shore, and is very shallow, and used only for local purposes. This city desires to construct a bridge from the American shore to the island, and from an examination of the laws relative thereto I am led to believe that it is in the power of the Secretary of War to permit the city to construct a bridge over any portion of a navigable stream, that will not interfere with the general navigation, without an act of Congress.

Will you kindly advise me whether under the circumstances you will grant to the city of Detroit the privilege of constructing a bridge as aforesaid, and greatly oblige,

Very respectfully, yours,

JNO. B. CORLISS,
City Attorney.

To the Hon. SECRETARY OF WAR.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
June 18, 1885.

Respectfully returned to the Secretary of War.

The ground taken by this Office, and heretofore adopted by the War Department, may be stated as follows:

When Congress has not authorized the construction of a bridge, or has not required the Secretary of War to approve the plan, &c., of a bridge as a condition to its being built, the Secretary of War cannot authorize or forbid its construction; but if he is satisfied that any intended structure of that kind or any other will seriously impair the navigation of the channels of the navigable waters of the United States, he has not failed to endeavor, through the Department of Justice, to prevent the erection of such structures. While it is true that the American channel is not much used, it is nevertheless a good channel of 24 feet depth, and should be maintained for obvious reasons.

It is clearly the opinion of this office that the construction of a bridge as proposed should only be permitted under authority of Congress upon such plan and at such location as shall receive the approval of the Secretary of War.

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

F F 2.

PROPOSED BRIDGE ACROSS THE WILLAMETTE RIVER AT PORTLAND, OREGON.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 23, 1885.

SIR: In reply to the reference to this office of the communication of May 18 from John H. Mitchell, attorney, inclosing a petition from the Columbia Street Bridge Company of Portland, Oregon, for approval by the War Department of the plan and location of a bridge proposed to be built across the Willamette River, I beg leave to refer to the proceedings in the case of the bridge across the Willamette River on or above Morrison street, in the city of Portland, authorized by the legislature of Oregon, of October 18, 1878, which is printed as Appendix B B 9 of the Annual Report of this office for 1882 (copy herewith), and to the letter therein of the Chief of Engineers to the Secretary of War of January 22, 1881, to the effect that Congress, by an act of June 23, 1874, authorizing the construction of a bridge across Willamette River at Portland, having (although the bridge was never built) assumed control and jurisdiction over the navigation of the Willamette River at Portland, and over the river generally, in other acts, by the appropriation of funds and the construction of works for its improvement, and imposed certain duties upon the Secretary of War in connection therewith, it would seem right and proper that the War Department should intervene for the protection and preservation of the navigable waters of the United States in the interests of commerce and navigation in this connection. But in view of the opinion of the Attorney-General of May 1, 1885, relative to the matter of the railroad bridge across the Mississippi at Saint Paul, it would now seem that this company (the Willamette being wholly in the State of Oregon) has the right to act under the law of the State authorizing the construction of this bridge, but in so doing will subject itself to the risk of future Congressional action, and it becomes questionable whether the matter can be interfered with or the location of the bridge approved by the War Department, as requested by the petitioners.

The papers are herewith returned.

Very respectfully, your obedient servant,

JOHN G. PARKE,
Acting Chief of Engineers.

Hon. WM. C. ENDICOTT,
Secretary of War.

LETTER OF THE SECRETARY OF WAR.

WAR DEPARTMENT,
Washington City, June 3, 1885.

SIR: I have the honor to acknowledge the receipt of your letter of the 18th ultimo, inclosing a petition and accompanying papers from the Columbia Street Bridge Company of Portland, Oreg., praying for the approval by this Department of the plans and location of a proposed bridge to be constructed by said company across the Williamette River from Madison street, in the city of Portland, to T street, in the city of East Portland, and stating that the construction of a bridge by said company is especially authorized by an act of the legislative assembly of the State of Oregon, approved February 26, 1885.

In reply I beg to state that I am of opinion that the Secretary of War has no authority, and that no officer of the Corps of Engineers having charge of the improvement of the Willamette River has authority, to approve the plans for a bridge over the said river, built by virtue of a statute of the State of Oregon; and, further, that the act of Congress of July 5, 1884, referred to in the letter of the Columbia Street Bridge Company, does not, under recent decisions of the Department of Justice, confer any authority upon the Secretary of War to act in relation thereto.

Very respectfully, your obedient servant,

WILLIAM C. ENDICOTT,
Secretary of War.

Hon. JOHN H. MITCHELL,
Attorney for the Columbia Street Bridge Company,
604 *Twelfth Street, City.*

F F 3.

PROPOSED BRIDGE ACROSS THE MONONGAHELA RIVER, NEAR FAIRMONT, WEST VIRGINIA.

FAIRMONT, W. VA., *August* 2, 1884.

DEAR SIR: I beg leave respectfully to submit the accompanying map, showing the proposed crossing of the Monongahela River for the Fairmont, Morgantown, and Pittsburgh Railroad, with the following reasons which have controlled us in the selection of that site for our bridge.

First. Fairmont being a point in our line fixed by our charter, and our road being a branch of the Baltimore and Ohio Railroad, located on the east side of the river, in order to reach that town we must cross at or below it.

Second. The West Virginia and Pennsylvania Railroad is located on the west side of the river, parallel to, and less than 100 feet from the track of the Baltimore and Ohio Railroad, from a point 1½ miles above Fairmont to the mouth of Buffalo Creek, 1½ miles below, and continuing along the river bank, is parallel to our own line throughout its length. From a point below Buffalo Creek to one some distance above the town, the grade of the road is 20 feet above that of the Baltimore and Ohio Railroad and our own.

Third. From the Baltimore and Ohio crossing, above Fairmont, to half a mile below Buffalo Creek, the hills are close and parallel to the river on both sides, and consequently to avoid tunneling and very costly work, both roads are located as near to the water's edge as safe construction will allow. Therefore a right-angle crossing of the stream, without using curves of less radii than are under any circum-stances allowable, cannot be obtained.

Fourth. The point selected is the only one within 3 miles of Fairmont at which, even with the use of so heavy a curvature as we have adopted on our eastern approach, we can avoid tunneling for a considerable distance on the east and twice crossing the West Virginia and Pennsylvania Railroad on the west side of the river.

Fifth. At the point selected, the west bank presents the only ground practicable for the sidings necessary for a proper connection between our own and the Baltimore and Ohio Railroad.

Believing that an inspection of the map presented will satisfy you of the correctness of the reasons above assigned, and that both the site adopted and the angle of our crossing are of necessity rather than of choice, we respectfully urge the shortness of the season remaining in which foundations in water can be safely constructed as a plea for your speedy decision allowing us to proceed with our work on the plans submitted.

Very respectfully, your obedient servant,

H. A. WHITING,
Engineer Fairmont, Morgantown and Pittsburgh Railroad.

Col. W. E. MERRILL,
U. S. Engineers.

REPORT OF LIEUTENANT-COLONEL WILLIAM E. MERRILL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, August 7, 1884.

GENERAL: I have the honor to submit the following report on the proposed bridge across the Monongahela River, near the mouth of Buffalo Creek, 1½ miles below Fairmont, W. Va.

In accordance with orders from the Adjutant General's Office, I visited Fairmont and inspected the location of the bridge in company with Mr. Randolph, chief engineer of the Baltimore and Ohio Railroad, and Major Whiting, chief engineer of the Fairmont, Morgantown, and Pittsburgh Railroad Company, which latter company is the one proposing to build the bridge in question.

Owing to the narrowness of the valley of the Monongahela, and the complications caused by the existence of a rival railroad (the West Virginia and Pennsylvania) parallel to the main stem of the Baltimore and

Ohio, and at a level about 20 feet higher, the crossing of the Monongahela is practically restricted to the site chosen, and I recommend that this site be approved.

The only questions remaining are those of the height and width between channel piers.

This part of the Monongahela is not now navigated except by rafts, but a survey has been made for an extension of the existing slackwater from Morgantown, its present terminus, to Fairmont; and the existence of a magnificent deposit of coal at Fairmont, extending up the West Fork to Clarksburg, is so great an inducement that it may fairly be assumed that at some future day this project will be realized. For the report on this subject see Report of the Chief of Engineers for 1876, Part II, page 129.

The proposed extension of slackwater contemplates the construction of the fifteenth dam, counting from Pittsburgh, at Holtz Mill, 2½ miles below Fairmont, and 1 mile below the proposed bridge. This dam will be built in the pool caused by Dam No. 14, having a low-water depth of six feet at this place, and will itself raise the low-water level to a height of 10 feet above this pool. The total increased height of low water at Holtz Mill will therefore be about 15 feet, which will give an increased height at the site of the proposed bridge of about 9½ feet. It is, therefore, evident that the low-water line from which our measurements are to be taken must be 9½ feet above the existing low water.

The following table shows the clear width and the height above low water of the channel-spans of all existing bridges over the Monongahela. The information was obtained under my orders by Capt. F. A. Mahan, Corps of Engineers.

Height above low water and clear width of channel-span of bridges over the Monongahela River.

Name of bridge.	Class of bridge.	By whom owned.	Number of spans.	Clear width of channel-span.	Height of channel-span above low water.	Assumed low-water level.
				Feet.	*Feet.*	
Point	Highway	Corporation	1	780	69.3	Pool of Davis Island Dam.
Smithfield street	do	do	2	344	51.8	Do.
Pan-handle	Railroad	Pittsburgh, Cincinnati, and Saint Louis Railroad.	5	247.4	53	Do.
Tenth street	Highway	Corporation	3	194	50	Do.
Homestead (Street's Run).	Railroad	Baltimore and Ohio Railroad.	8	300	59.4	Pool No. 1, Monongahela River.
Glenwood (city farm)	do	Pittsburgh, McKeesport, and Youghiogheny Railroad.	6	250	54	Do.
Port Perry	do	Pennsylvania Railroad.	9	253	57	Do.
McKeesport	do	Pittsburgh, McKeesport, and Youghiogheny Railroad.	6	221	40	Pool No. 2, Monongahela River.
Monongahela City	Highway	Corporation	4	216	(*)	Pool No. 3, Monongahela River.
Coal Centre (Greenfield)	Railroad	O. & B. S. L. Railroad.	......	......	......	Pool No. 4, Monongahela River.
Brownsville	Highway	Corporation	3	218	41.5	Do.

* Superstructure burned about two years ago.

It will be seen from this table that the least widths for navigation are given by the Tenth Street Bridge, the bridge at Brownsville on the National Road, and the bridge at Monongahela City, recently burned. All these bridges are very old, and were built before the recent advance in bridge-building. The next narrowest space is at McKeesport Bridge, the newest bridge on the river. While I think that the clear opening of this bridge should be increased, yet in view of the fact that it will be many years before there is any navigation to Fairmont, and of the further fact that there is always less navigation at the head of a river than near its mouth, I do not think it would be reasonable to require of the bridge near Fairmont a greater clear opening than is now afforded at McKeesport. I would therefore recommend that for the proposed bridge at the mouth of Buffalo Creek the clear opening measured on the low-water line at right angles to the current be fixed at 220 feet.

To accommodate the approaches on each bank, the line of the bridge makes an angle of 38 degrees with a line normal to the current. There is no objection to this obliquity, provided the piers are placed parallel to the current, and the distance between them, measured at right angles to the current, is at least 220 feet. In the case in question this requirement would make the distance between centers of piers about 296 feet, depending on their top widths and batter. This amount of space for navigation is only required for the channel span; the piers of the other spans may be located to suit the interests of the Bridge Company.

In reference to the question of height above low water, an inspection of the table shows that the minimum height is 40 feet at McKeesport. This bridge has recently been built, and it has never been approved by the United States authorities. It is my present opinion that it is too low, and I therefore recommend that the next lowest, the Brownsville Bridge, be taken as the standard, and that the height of 41½ feet above low water of the proposed slackwater be prescribed. At the site selected by the Fairmont, Morgantown and Pittsburgh Railroad Company the bottom of the bridge superstructure would therefore have to be 41½ feet above Pool 15 of the Monongahela slackwater, or 51 feet above the present low-water line.

The proposed height, as shown on the drawings, is 41 feet, measured to the base of rail, or about 39 feet measured to bottom of the bottom chord, depending on the style of floor adopted. In other words, the bridge, as shown on the tracing presented by the Bridge Company, must be raised 12 feet.

I would, therefore, recommend that the site and plans be approved on condition that at least one channel-span be provided giving a clear opening of 220 feet, measured at right angles to the current, on the surface of the proposed level of the fifteenth pool, and that the under side of the bridge be 41½ feet above the same level.

Accompanying this report is a tracing showing the Monongahela River from Fairmont to Buffalo Creek, with the three lines of railroad, and also a letter from Major Whiting giving reasons why the Fairmont, Morgantown and Pittsburgh Railroad Company was compelled to select for its bridge the site in question.

Very respectfully, your obedient servant,

WM. E. MERRILL,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 24, 1884.

SIR: I have the honor to return herewith the letter from the president of the Fairmont, Morgantown and Pittsburgh Railroad Company, inclosing tracing showing line for proposed bridge over the Monongahela River, below Fairmont, and the papers accompanying the same, and also protests of the town of Palatine and of the Chamber of Commerce of Pittsburgh, &c., and to invite attention to the accompanying reports thereon of Lieut. Col. W. E. Merrill, Corps of Engineers, to whom was assigned the duty of examining the plan and location of the proposed bridge. Colonel Merrill's views and recommendations seem to be just and proper and in the interests of navigation, and are concurred in. It is suggested, however, in order to meet, as far as practicable, the wishes of the authorities of the town of Palatine, that an additional proviso be made to the effect that the channel-span shall cover the course usually traveled by rafts when passing the site of the bridge, and that the opinions of raftsmen be consulted in the matter; and also that the location of the channel-spans be supervised by Lieut. Col. W. E. Merrill, Corps of Engineers, if so desired by the parties interested.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

The suggestion of the Chief of Engineers is approved.
By order of the Secretary of War.

JAY STONE,
Acting Chief Clerk.

WAR DEPARTMENT, *September* 30, 1884.

REPORT OF LIEUTENANT-COLONEL WILLIAM E. MERRILL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Marietta, Ohio, October 10, 1884.

GENERAL: I have the honor to state that I visited Fairmont, W. Va., on the 9th instant, in company with Mr. Randolph, chief engineer of the Baltimore and Ohio Railroad, and Major Whiting, engineer of the bridge now building over the Monongahela River, 1½ miles below Fairmont, and I have to submit the following report on the relations of the said bridge to navigation:

The first question to be settled was the exact location to be given to the channel-span, in order to meet the necessities of the existing rafting navigation on this river. At my request the railroad company called together a number of raftsmen, and had them meet us at the bridge site. After examination and discussion, they unanimously agreed that the channel-span should be placed next to the right-hand shore.

The next question was that of the width to be given to the channel-span. The bridge engineers placed a buoy in the river 240 feet from the right-hand abutment, measured on the axis of the bridge, and 190 feet from it, measured at right angles to the current. After examining this position from the bank, and visiting the locality in skiffs, they unanimously agreed that the location in question would be satisfactory to the rafting interest, and they stated that it would give them much more room than they now have at the railroad bridge over the Monongahela, one mile above Fairmont, which they have always passed with rafts without annoyance or accident. I am informed by the railroad engineers that this bridge has 200-foot spans on a 45-degree skew, making 140 feet at right angles to the current.

If this location of the left-hand channel pier is approved, the railroad company proposes to fill the gap between it and the left-hand abutment with two piers, making three additional spans of 148 feet between centers, as shown in the accompanying tracing furnished by Major Whiting.

Although this arrangement gives a less width of channel span than I had previously recommended I advise its adoption, because width of span is chiefly needed for the rafting interest, and the width in question is satisfactory to that interest. There is no steamboat navigation at present on this part of the Monongahela River, and there will be none until slackwater is created from Morgantown to Fairmont. The construction of an artificial pool at this locality would so reduce the current that a steamboat would have no difficulty in passing through the proposed channel span, whether ascending the river or descending.

As to the height of the proposed bridge—a matter of great concern to steamboats, but wholly unimportant to rafts—I desire to make no change in my previous recommendation; but inasmuch as this great height is only needed in case of slackwater to Fairmont, which, under the most favorable circumstances, cannot be expected for many years, I would recommend that the railroad company, if they desire it, should have the privilege of building this bridge at the height originally proposed by them, *provided* they will guarantee to raise the bridge to the height which I have recommended whenever duly called upon by the honorable Secretary of War. It is a hardship to compel them to build a bridge of great height without a public necessity for such height, and as this public necessity does not now exist and may never exist, I think it but fair to give them the option of meeting the present wants of the public at the minimum cost, *provided* they will bind themselves to make this bridge conform to the possible public necessities of the future.

I would further recommend that all of the spans of the bridge be required to be "through" spans, and that no riprap be allowed around the piers.

It is my understanding that the railroad company contemplates meeting both of these requirements, but I think it advisable to mention them in this report.

Respectfully submitted.

WM. E. MERRILL,
Lieut. Col. of Engineers.

General JOHN NEWTON,
Chief of Engineers.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
October 15, 1884.

Respectfully submitted to the Secretary of War, inviting attention to the previous papers on the subject, especially to the letter from this office of September 24, 1884.

It is recommended that Colonel Merrill's views be approved, and that I be authorized to inform the president of the railroad company accordingly, sending a copy of Colonel Merrill's letter and the accompanying tracing, and requesting him to signify acceptance by the company of the conditions contained therein.

JOHN G. PARKE,
Acting Chief of Engineers.

[Second indorsement.]

The recommendation of the Acting Chief of Engineers is approved, and will be carried out.

A copy of the report of Colonel Merrill, the indorsement of the Acting Chief of Engineers, and the approval of the Secretary of War will be furnished the mayor of Palatine, W. Va., as verbally requested by the Hon. Mr. Wilson this day.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT, *October* 18, 1884.

F F 4.

PROPOSED BRIDGE OF THE NORTHERN PACIFIC RAILROAD COMPANY ACROSS SAINT LOUIS RIVER, MINNESOTA AND WISCONSIN.

NORTHERN PACIFIC RAILROAD COMPANY,
PRESIDENT'S OFFICE,
New York, April 9, 1884.

SIR: By act of Congress approved February 27, 1873, the Northern Pacific Railroad Company is authorized to construct a bridge across the Saint Louis River between Rice's Point, in the State of Minnesota, and Connor's Point, in the State of Wisconsin, upon certain conditions prescribed in said act.

Section 2 of the act reads as follows:

> That the piers of said bridge shall be built parallel with the current at that stage of the river which is most important for navigation.

In section 3 it is provided as follows:

> If it shall be found that the conditions prescribed by this act cannot be complied with at the location where it is desired to construct the bridge, the Secretary of War shall, after considering any remonstrances filed against the building of the bridge and furnishing copies of such remonstrances to the Board of Engineers provided for in this act, detail a Board, composed of three experienced officers of the Corps of Engineers to examine the case, and on their recommendation authorize such modifications in the requirements of this act as to location and piers as will permit the construction of the bridge. not, however, diminishing the width of the span contemplated by this act, provided that the free navigation of the river be not materially injured thereby.

The Northern Pacific Railroad Company desires to proceed with the construction of the bridge across the Saint Louis River, but it is considered inadvisable to build it between Rice's Point and the extreme north end of Connor's Point, for the following reasons:

First. The channel of the Saint Louis River runs at an acute angle to the line from Rice's to Connor's Point. It will, therefore, be impossible for the piers of the bridge to be parallel with said channel unless they are built at an equally acute angle with the bridge itself, thereby making an awkward, inconvenient, and very expensive structure. The draw part of the bridge, if so constructed, can only be opened in one direction, which may at times be a serious evil in operating the bridge and in allowing vessels to pass through the draw promptly.

Second. Above or beyond Connor's Point is a bay of considerable magnitude, upon which several wharves have already been built and the early erection of others is proposed. It is an excellent point for shipping, and a very large business will be done from such wharves. In case the bridge is built direct from Rice's Point to Connor's Point, all this shipping will be compelled to pass through the draw both ways.

Third. Connor's Point is now largely occupied with saw-mills, planing-mills, and similar works for manufacturing wood. The constant running of trains that would follow the construction of the bridge between Rice's Point and Connor's Point would be extremely hazardous to the buildings and lumber. The value of the latter at times is several hundred thousand dollars and will be greater in future.

For the reasons above stated, the Northern Pacific Railroad Company desires to locate the bridge from Rice's Point in Minnesota across Saint Louis River and the Bay of Saint Louis to a point on the Wisconsin shore about five-eighths of a mile above Connor's Point, as shown on the map herewith transmitted, and the undersigned requests that a Board of Engineers be appointed, as provided in the third section of the act referred to, to consider and report upon the matter.

I have the honor to be, very respectfully, your obedient servant,

ROBERT HARRIS,
President.

HON. ROBERT T. LINCOLN,
Secretary of War.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
May 6, 1884.

Respectfully returned to the Secretary of War, inviting attention to the within report of Maj. C. J. Allen, Corps of Engineers, the officer in charge of the improvement of Superior Bay, to whom it was referred, from which it will appear that the map accompanying the communication of the president of the railroad company does not convey the requisite information upon the subject and cannot be considered as such a compliance with the requirements of section 3 of the act of February 27, 1873, as will enable the Secretary of War to decide as to the propriety of the proposed change in the location of the bridge. Neither do the reasons presented by the president of the company seem to constitute such a remonstrance as is contemplated by the act. It is suggested, therefore, that the railroad company be requested to furnish the map and drawings required by the act, with the view to submitting them to the Board of Engineers that may be detailed to examine the matter. There is no objection to the detail of a Board; indeed the case would seem to require one when the requisite information to enable it to act intelligently has been provided.

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

REPORT OF MAJOR CHARLES J. ALLEN, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
Saint Paul, Minn., April 28, 1884.

GENERAL: I have the honor to return herewith the letter of the president of the Northern Pacific Railroad Company, with its inclosures (map and printed copy of legislation affecting that road) referred to me by indorsement, Office of the Chief of Engineers, April 19.

I also inclose, to aid in reporting upon the proposed crossing, a small tracing of a portion of Saint Louis Bay, made from a chart, Lake Survey, 1861. On this tracing I have located, approximately, a proposed channel on the west side of Rice's Point, reported upon by a Board of Engineers, January 29, 1881; there is also approximately located on the tracing the established dock line, Wisconsin side Saint Louis Bay, as shown on the map accompanying letter of the president of the company.

Section 3, act of Congress approved February 27, 1873, requires to be submitted to the Secretary of War, "a design and drawing of the bridge and piers, and a map of the location, giving for the space of at least one mile above and one mile below the proposed location the topography of the banks of the river, the shore lines at high and low water, the direction of the current at all stages, and the soundings showing accurately the bed of the stream."

Section 1 of the act provides for a pivot draw, giving two clear openings of 100 feet each, measured at right angles to the current at the average stage of water in the river, and located in a part of the bridge that can be safely and conveniently reached at that stage, the next adjoining spans to the draw to be not less than 150 feet. Bottom chord of bridge not less than 10 feet above extreme high-water mark.

It is assumed in the absence of drawings that the usual draw-rest above and below the pivot pier is contemplated, and that the approaches to the draw are designed to not unduly contract the width or cross-section of discharge.

I communicated with officials of the railroad engineer office at Saint Paul, but, owing to the absence of the chief engineer, could not obtain any information other than that on the map accompanying the letter referred to me. A tracing of a portion of the map was sent, for verification, to my assistant at Duluth, who reported it "not correct in channel or soundings." The map appears to have been compiled from a Lake Survey chart, 1861, and from a map of the Engineer Department, 1879. Changes, natural and artificial, have taken place since those dates. There is information sufficient in this office to supplement the map below Rice's and Connor's points, but reliable soundings between those points, and the site proposed, and for a mile above the site; and a correct longitudinal section on the axes of the bridge, showing piers, bed of river, &c., are needed. No general survey of the Saint Louis River has been made, so far as known, since 1861.

The crossing, as now proposed by the company, makes for a point on the Wisconsin side of Saint Louis Bay, about five-eighths of a mile above the point originally intended. The reasons for this change, as stated in the letter of Mr. Harris, are strong. But, as a draw at the originally intended crossing would not restrict ascending vessels, after passing it, to any particular channel, it appears necessary to add the following in regard to the line as now proposed: By inspection of the small tracing, from Lake Survey chart, 1861, it will be seen that vessels drawing 16 feet of water can, after passing the proposed draw, only ascend the bay for a short distance, and along the west side of Rice's Point, after the 16-foot channel along this point shall have been provided.

Dredging to accommodate vessels of 16-foot draught will undoubtedly be required at some future time on the Wisconsin side of the bay and along the front of the established dock line.

Should communication between these channels, across the bay and above the bridge, be desired for such vessels, it could be obtained by dredging across the bay, and at right angles, or nearly so, to the flow of the stream, or, by carrying a channel up the river for about 2 miles above the draw, thence to double upon itself.

The former would undoubtedly be objectionable, and the latter would not be generally convenient, to say the least.

It is suggested that this difficulty can be met by providing for an additional draw of 100 feet opening, whenever necessary in the interests of navigation, at the southerly (Wisconsin) end of the crossing. By proper dredging at this point it is believed that parallelism of the piers to the line of docks established need not be required if it be objected to curving the line of crossing so as to secure such parallelism.

The act of February 27, 1873, provides for the consideration of remonstrances against the bridge. None have been received at this office thus far.

Before this location can be definitely reported upon a correct map showing soundings and channels, and a longitudinal section of the bridge, should be furnished by the company.

Very repectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF BOARD OF ENGINEERS.

DULUTH, MINN., *July* 23, 1884.

SIR: The Board of Engineers constituted by paragraph 7, Special Order No. 155, Headquarters of the Army, Adjutant-General's Office, Washington, D. C., July 5, 1884, to consider and report upon certain questions, as provided in section 3 of the act of Congress approved February 27, 1873, "to authorize the Northern Pacific Railroad Company to construct and maintain a bridge across the Saint Louis River," has the honor to submit the following report:

The Board assembled at Duluth, Minn, at 10 o'clock a. m., July 22, pursuant to the call of the senior member, and after consideration of the letter of the Chief of Engineers, July 9, and the papers and maps referred to therein, visited the proposed location of the bridge.

Section 1 of the act of Congress approved February 27, 1873, provides for the construction and maintenance by the Northern Pacific Railroad Company of a draw-bridge across the Saint Louis River between Rice's Point, in the State of Minnesota, and Connor's Point, in the State of Wisconsin, the bridge not to be of less height than 10 feet above the level of the water of the river at the point where its construction is authorized; to have a pivot draw giving two clear openings of 100 feet each, measured at right angles to the current at the average stage of water in the river, and located in a part of the bridge that can be safely and conveniently reached at such stage, and the next adjoining spans to the draw not to be of less width than 150 feet, provided the proper location of the draw over the channel admits of spans of such width between it and the shore. Section 3 provides that in case the conditions prescribed in this act cannot be complied with at the location named in section 1, the Secretary of War shall, after considering any remonstrances filed against the building of the bridge, detail a Board of three experienced officers of the Corps of Engineers to examine the case, and on their recommendation authorize such modifications in the requirements of this act, as to locations and piers, as will permit the construction of the bridge, not, however, diminishing the width of the spans contemplated by the act. Section 7 reserves to Congress the right to alter or amend this act so as to prevent or remove all material obstructions to navigation, and also provides that if any change be made in the plan of construction during the progress of the work, or before its completion, the same shall be subject to the approval of the Secretary of War.

The Board has referred at some length to the provisions of the act of Congress authorizing the bridge, in order that the matter may be clearly understood.

The Northern Pacific Railroad Company now proposes, under the provisions of section 3, to change the location of the bridge so as to make the crossing from Rice's Point, in Minnesota, to a point on the Wisconsin side of the river about five-eighths of a mile above Connor's Point, between which and the point is an indentation or bay available for business purposes. The principal reasons assigned for the proposed change, as set forth in the letter of Mr. Robert Harris, president of the company, under date of April 9, 1884, to the Hon. Secretary of War, are the engineering difficulties attendant upon constructing the bridge on the line from Rice's to Connor's Point, and the fact that Connor's Point is now largely occupied by saw-mills, planing mills, and similar works, and the danger to such that would follow the constant running of trains in close proximity to them, concurred in by property owners and householders on Connor's Point in their remonstrance to that effect dated June 9, 1884. The fears expressed in this remonstrance appear to be well founded, and to constitute a good and sufficient reason for a change in location. In addition, the Board is of opinion that there is greater objection to the construction of a bridge from Rice's Point to Connor's Point than along the proposed line, arising from possible effects upon the channels of the harbor.

The plan of the bridge, as submitted to the Board, consists of an approach of trestle-work 320 feet in length, commencing at Rice's Point, a span of 150 feet in width, a draw with two openings of 100 feet in the clear each, then a span of 150 feet, and thence trestle-work to the Wisconsin shore, the aggregate length of the bridge being 4,854 feet over all.

The location of the draw as now proposed and as shown upon the map furnished by the company to the Secretary of War, dated June 12, 1884, lies wholly within the channel, and is properly placed, the pier of the northerly opening being just at the wharf line recently established by the village of Duluth, and shown on the map by a broken red line.

By reference to the map it is seen that the location of the draw, as proposed, restricts the course of ascending vessels of considerable draught, after they shall have passed the draw, to the northerly or Minnesota side of the bay, as the channels now are. It may be necessary in the future for such vessels to make landings along the recently established dock line on the Wisconsin side of the bay, as shown upon the map, to assure which a suitable opening of at least equal capacity to that now provided at the Minnesota or northerly end of the bridge should be constructed by the company at the southerly or Wisconsin end whenever, in the future, the Secretary of War may determine such opening to be necessary in the interest of navigation; the opening as to plan, location, and construction to be subject in all respects to the approval of the Secretary of War, and to be operated and lighted in consonance with the provisions of sections 1 and 4 of the act approved February 27, 1873; and it is advised that the approval of the Secretary to the present proposed location contain a condition to this effect. The crossing being of trestle-work, the construction of such an opening, when necessity may require it, will be comparatively easy.

RECOMMENDATIONS.

The Board recommends approval of the proposed location of the bridge, and of the plans therefor, with the following modifications:

1. That the span between the draw-span and Rice's Point be omitted and trestle or other work substituted.
2. That, under the provisions of the third section of the act, the railroad company shall be subjected to the requirement to construct, whenever notified by the Secretary of War to do so, a draw near the Wisconsin shore of equal capacity with the one near Rice's Point.

Respectfully submitted.

O. M. Poe,
Lieut. Col. of Engineers, Bvt. Brig. Gen., U. S. A.
A. Mackenzie,
Major of Engineers.
Chas. J. Allen,
Major of Engineers.

LETTER OF THE CHIEF OF ENGINEERS.

Office of the Chief of Engineers,
United States Army,
Washington, D. C., August 5, 1884.

Sir: I have the honor to return herewith the letter of the president of the Northern Pacific Railroad Company of the 23d June last, and the maps referred to therein, together with other papers on the subject, and to submit, in connection therewith, the inclosed report of the Board of Engineers constituted by Special Orders 155, Headquarters of the Army, Adjutant-General's Office, dated July 5, 1884, "to consider and report upon certain questions as provided in section 3 of the act of Congress approved February 27, 1873, 'to authorize the Northern Pacific Railroad Company to construct and maintain a bridge across the Saint Louis River,'" with recommendation for approval.

If approved, I beg also respectfully to suggest that I be authorized to furnish the president of the Northern Pacific Railroad Company with a copy of the report, and to request that he signify in writing the acceptance by the company of the conditions and recommendations contained therein.

Very respectfully, your obedient servant,

John Newton,
Chief of Engineers, Brig. and Bvt. Maj. Gen.

Hon. Robert T. Lincoln,
Secretary of War.

[First indorsement.]

The recommendation of the Chief of Engineers is approved, and the authority requested is granted.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT, *August* 16, 1884.

LETTER OF PRESIDENT OF THE NORTHERN PACIFIC RAILROAD COMPANY.

NORTHERN PACIFIC RAILROAD COMPANY,
PRESIDENT'S OFFICE,
New York, August 28, 1884.

SIR: I have the honor to acknowledge the receipt of your letter of the 25th instant, with two inclosures—namely, a copy of the report dated July 23, 1884, of the Board of Engineers, constituted by paragraph 7 Special Order No. 155, Headquarters of the Army, Washington, D. C., July 5, 1884, to consider and report upon certain questions, as provided in section 3 of the act of Congress entitled "An act to authorize the Northern Pacific Railroad Company to construct and maintain a bridge across the Saint Louis," approved February 27, 1873, and a copy of a letter of the Chief of Engineers, dated August 5, 1884, to the Hon. Robert T. Lincoln, Secretary of War, recommending for approval the report of the Board of Engineers, with a copy of the Secretary's approval thereunder written.

The Board of Engineers say in their report that it may be necessary in the future for vessels of considerable draught to make landings along the recently-established dock-line on the Wisconsin side of the bay, as shown upon the map referred to in the report, and to assure which a suitable opening of at least equal capacity to that now provided at the Minnesota or northerly end of the bridge should be constructed by the company at the southerly or Wisconsin end, whenever in the future the Secretary of War may determine such opening to be necessary in the interests of navigation, the opening, as to place, location, and construction, to be subject in all respects to the approval of the Secretary of War, and to be operated and lighted in consonance with the provisions of sections 1 and 4 of the act of Congress; and they advise that the approval of the Secretary to the present proposed location of the bridge contain a condition to this effect.

The Board of Engineers recommend approval of the proposed location of the bridge, and of the plans therefor, with the following modifications, viz:

1. That the span between the draw-span and Rice's Point be omitted, and trestle or other work substituted.
2. That under the provisions of the third section of the act the railroad company shall be subjected to the requirement to construct, whenever notified by the Secretary of War to do so, a draw near the Wisconsin shore of equal capacity with the one near Rice's Point.

In compliance with your request, and the recommendation of the Chief of Engineers, approved by the Secretary of War, and by authority of a resolution of the Board of Directors of this Company, I have the honor to hereby signify and make known that the Northern Pacific Railroad Company accepts the conditions and recommendations contained in the report of the Board of Engineers.

Very respectfully, your obedient servant,

ROBERT HARRIS,
President

General JOHN G. PARKE,
Colonel of Engineers, U. S. A.

PETITION OF LAND AND RIVER IMPROVEMENT COMPANY IN REFERENCE TO A DRAW ON THE WISCONSIN SIDE OF SAINT LOUIS BAY.

To the Hon. ROBERT T. LINCOLN,
Secretary of War:

The petition of the Land and River Improvement Company respectfully represents that your petitioner is a corporation duly organized and existing and authorized by its charter to purchase, hold, sell, or otherwise dispose of real estate in the State of Wisconsin.

That your petitioner is the owner of a large amount of lands lying upon the Bay of Superior and on the Saint Louis Bay, in the town of Superior, county of Douglas and State of Wisconsin, and has erected and proposes to erect valuable improvements thereon. That the lands of your petitioner upon said Saint Louis Bay comprise an extensive and very valuable dock frontage. That the Wisconsin end of the bridge now being erected by the Northern Pacific Railroad Company across said Saint Louis Bay is in about the middle of said dock frontage.

That your petitioner, in order to develop the commerce of said Saint Louis Bay, and promote industries upon said dock frontage, has furnished to various railway companies and other corporations and persons large quantities of said land, among others to the Chicago, Saint Paul, Minneapolis and Omaha Railway Company, the Saint Paul, Minneapolis and Manitoba Railway Company, the Saint Paul and Duluth Railway Company, the Northern Pacific Railroad Company, the Dakota and Minnesota Elevator Company, and other elevator, mill, and coal companies for the construction of railroad docks, mills, elevators, coal docks, and other industries, and is engaged in procuring the location of other industries of a similar nature upon said bay front. That the said railroad docks and other industries now located on either side of said bridge approach will require water facilities, and will be approached by large vessels. That unless the said Northern Pacific Railroad Company is required to place a draw in its said bridge upon the Wisconsin side of said bay, the commerce of said harbor will be seriously and materially obstructed and impeded. That it is absolutely necessary to the proper development of the commerce of said harbor that such draw should be constructed, for the reason that the draw now being constructed is so near to the Minnesota shore of said bay that it will furnish no facilities to the commerce seeking the Wisconsin shore of said bay. That the waters of said bay adjacent to the established dock-line in front of said lands of your petitioner are navigable, and that your petitioner has already spent a large sum of money improving the channel by dredging across the bridge line in the waters of said bay upon the Wisconsin side thereof.

Wherefore your petitioner prays that an order be issued requiring the said Northern Pacific Railroad Company to put in its said bridge a draw upon the Wisconsin side of said bay, at such point as may be found proper therefor. And your petitioner will ever pray, &c.

Dated December 11, 1884.

LAND AND RIVER IMPROVEMENT COMPANY,
By FRANCIS H. WEEKS,
President.
J. H. HAMMOND,
General Manager.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
December 26, 1884.

Respectfully referred to Maj. C. J. Allen, Corps of Engineers for report.

To be returned.

JOHN G. PARKE,
Acting Chief of Engineers.

[Second indorsement.]

ENGINEER OFFICE, U. S. ARMY,
Saint Paul, Minn., December 31, 1884.

Respectfully returned.

The Board of Engineers constituted by paragraph 7, Special Order No. 155, Headquarters of the Army, Adjutant General's Office, Washington, D. C., July 5, 1884, to consider and report upon the proposed Northern Pacific Railroad Company bridge across the Saint Louis River, Minnesota and Wisconsin, authorized by act of Congress approved February 27, 1873, recommended in their report, dated July 23, 1884, that the railroad company be subjected to the requirement to construct, whenever notified by the Secretary of War to do so, a draw near the Wisconsin shore of equal capacity with the one near Rice's Point. This recommendation, as a condition, was accepted by the railroad company, as per letter of the president thereof to the honorable Secretary of War, dated August 28, 1884.

The petitioners state that extensive improvements have been commenced on the Wisconsin side of Saint Louis Bay, location of dock lines and dredging included. Extensive dock lines have been located, although the docks are not as yet built. The amount of dredging I should consider as small, and not exceeding 2,000 to 3,000 cubic yards of excavation.

The importance of the present developments and the prospective commerce I believe to be not overrated by the petitioners.

I would therefore recommend that the railroad company be required to construct the additional draw according to plans to be approved by the Secretary of War.

CHAS. J. ALLEN,
Major of Engineers.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 16, 1885.

SIR: I have the honor to return herewith the petition of Francis H. Weeks, president, and J. K. Hammond, general manager, of the Land

and River Improvement Company (Wisconsin), dated December 11, 1884, that the Northern Pacific Railroad Company be required to put a draw in its bridge on the Wisconsin side of Saint Louis Bay, and also the protest of the Northern Pacific Railroad Company, by Robert Harris, president, dated December 27, 1884, against the favorable consideration of the matter, both of which were referred to this office for report.

"An act to authorize the Northern Pacific Railroad Company to construct and maintain a bridge across the Saint Louis River," approved February 27, 1873 (United States Statutes, Vol. 17, p. 477), contains in section 3 the usual provisions requiring that plans, &c., be submitted to the Secretary of War for approval, and adds—

> But if it shall appear that the conditions prescribed by this act cannot be complied with at the location where it is desired to construct the bridge, the Secretary of War shall, after considering any remonstrances filed against the building of said bridge, and furnishing copies of such remonstrances to the Board of Engineers provided for in this act, detail a Board composed of three experienced officers of the Corps of Engineers, to examine the case, and, on their recommendation, authorize such modifications in the requirements of this act, as to locations and piers, as will permit the construction of the bridge, not, however, diminishing the width of the spans contemplated by this act: *Provided*, That the free navigation of the river be not materially injured thereby.

Remonstrances against the proposed location of the bridge having been made, a Board of Engineers was, by authority of the Secretary of War, organized by paragragh 7 of Special Orders number 155, Headquarters of the Army, Adjutant-General's Office, dated July 5, 1884, to consider and report upon certain questions, as provided for in the third section above referred to. The Board assembled at Duluth July 22, and submitted its report July 23, 1884, in which the following language is used:

> By reference to the map it is seen that the location of the draw, as proposed, restricts the course of ascending vessels of considerable draught, after they shall have passed the draw to the northerly or Minnesota side of the bay as the channels now are. It may be necessary in the future for such vessels to make landings along the recently established dock line on the Wisconsin side of the bay, as shown upon the map, to assure which a suitable opening of at least equal capacity to that now provided at the Minnesota or northerly end of the bridge should be constructed by the company at the southerly or Wisconsin end whenever, in the future, the Secretary of War may determine such opening to be necessary in the interest of navigation; the opening as to plan, location, and construction to be subject, in all respects, to the approval of the Secretary of War, and to be operated and lighted in consonance with the provisions of sections 1 and 4 of the act approved February 27, 1873; and it is advised that the approval of the Secretary to the present proposed location contain a condition to this effect, &c.

The recommendations of the Board were approved by the Secretary of War August 16, 1884.

A copy of the report of the Board was furnished the president of the railroad company, who, in acknowledging its receipt, under date August 28, 1884, used the following language:

> I have the honor to hereby signify and make known that the Northern Pacific Railroad Company accepts the conditions and recommendations contained in the Report of the Board of Engineers.

By reference to Major Allen's reports upon the petition and protest referred to in this letter it will be seen that, basing his opinion upon the papers received by him from the parties interested, pro and con, he is led to the conclusion "that the railroad company be required to construct the additional draw according to plans to be approved by the Secretary of War."

I concur in his recommendation.

The previous papers in the case, including its report of the Board of Engineers, are herewith.

The letter of Mr. C. L. Catlan is also returned.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

[First indorsement.]

The recommendation of the Chief of Engineers that the Northern Pacific Railroad Company be required to construct an additional draw on the Wisconsin side in its bridge across the Saint Louis River or Saint Louis Bay, according to plans to be approved by the Secretary of War, is approved, and it is so ordered. The Chief of Engineers will advise the railroad company accordingly, and take the necessary steps to carry this order into effect.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT, *January* 17, 1885.

APPENDIX G G.

IMPROVEMENT OF HARBOR AT DULUTH, MINNESOTA, AND OF THE ENTRANCE TO SUPERIOR BAY, LAKE SUPERIOR—IMPROVEMENT OF THE HARBOR AT GRAND MARAIS, MINNESOTA.

REPORT OF MAJOR CHARLES J. ALLEN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Harbor at Duluth, Minnesota.
2. Dredging Superior Bay, Wisconsin.
3. Harbor at Grand Marais, Minnesota.

EXAMINATIONS AND SURVEYS.

4. Big Stone Lake and Lake Traverse, Minnesota, with a view to connecting them.
5. Agate and Burlington bays, Minnesota.
6. Saint Louis Bay and Saint Louis River from Connor's Point, Wisconsin, and Rice's Point, Minnesota, to foot of first falls.

(For letter of transmittal, see Appendix A. A.)

G G 1.

IMPROVEMENT OF HARBOR AT DULUTH, MINNESOTA.

The present project of improvement is based upon the report and estimates of a Board of Engineers convened in January, 1881, and contemplates the maintenance of the existing dredged areas and enlargement of the harbor by dredging, as follows:

1. On a line from Rice's to Minnesota Point.
2. On a line past the Blast Furnace Docks to intersect with the channel of the Saint Louis River.
3. On a line parallel to Minnesota Point; and,
4. Along the west side of Rice's Point, in Saint Louis Bay.

The dredging to provide for vessels drawing 16 feet.

The cost of the project, including maintenance of the canal-piers for the present, as stated in annual report, 1881, was placed at $212,988.36. This estimate, as revised in annual report for 1884, was increased to $305,424. The river and harbor act of Congress approved July 5, 1884, appropriated $45,000 for continuing improvement. This sum was applied to dredging and to maintenance of the piers. A contract for dredging was entered into with Williams and Upham, September 19, 1884, to be completed by September 1, 1885. Under this contract 173,102 cubic yards of material were removed during the fiscal year.

The pier-head of the south pier was badly damaged during the storm of October 1 by vessels colliding with it. The work had been standing for about ten years, and needed extensive repairs or renewal. It was accordingly repaired and partly rebuilt from the water-surface. Upon these repairs, completed in November, were expended—

Timber, feet, B. M	60,952
Brush, cords	10
Rock-filling	64.62
Drift-bolts and spikes, pounds	6,979

Some of the old material in the structure having been utilized.

This pier-work was done by hired labor, and economically carried out by Mr. Guy Wells, assistant engineer.

Thorough soundings, taken over large areas of the harbor during the fall of 1884, for comparison with those of the survey of 1879, showed that more or less of scour and fill had taken place within the entire harbor, the total movement of material during the five years probably aggregating nearly a million of cubic yards. On account of the movement of the material forming the bed of the harbor, it will be necessary to provide for a small amount of redredging for several years to come.

The condition of the harbor and piers is as follows:

Piers in good condition, excepting a slight settling at the middle point of the south pier. This pier-work was originally done by the city of Duluth, the superstructure having received repairs at the hands of the Government since 1873. The main harbor area in front of the docks, about 3,000 feet in length by 900 to 1,130 feet in width, has depth of 17 feet. In the canal the least depth is 17 feet. The channel leading from the main harbor to the blast-furnaces on Rice's Point has, for a distance of 1,600 feet, a depth of 16 feet, the widths varying from 65 to 120 feet; thence to the Saint Louis River the dredged channel is narrow, with ruling depth of 12 feet. No work has been done upon the channel from the blast-furnaces to the Saint Louis River since 1881.

Before adoption of the present plan the harbor area was much restricted, and there was no channel of consequence along the east side of Rice's Point.

If the recommendation of the officer in charge of the Saint Mary's Falls Canal be adopted, viz, the construction of a new lock to afford depth of 21 feet on the miter-sill, the anchorage-ground and channels of Duluth Harbor will have to be deepened accordingly.

In pursuance of the present plan of improvement the sum of $125,000 can be profitably expended during the fiscal year ending June 30, 1887, in dredging, especially in deepening and enlarging the main harbor area, and in maintenance of the piers.

A reserve of $8,000 to $10,000 with which to make repairs to piers when necessary should always be available.

The balance from appropriations available at the close of the fiscal year 1885 will be expended in completion of the dredging contract and in necessary repairs to piers.

As bearing upon the extent of dredging during the season of 1885, a copy of letter from a committee of the Chamber of Commerce of Duluth, dated April 16, 1885, is herewith. The request of the committee accorded with the views of this office regarding the season's work.

The work, with the exception of that upon the piers in the fall of 1884, has been in local charge of Assistant J. H. Darling, assisted by D. W. Kinnaird and Thomas McMath. These gentlemen have discharged the duties devolving upon them well and faithfully.

The very complete statistics pertaining to this and other ports and works have been compiled by Mr. William Blankenhorn, chief clerk.

This work is in the collection district of Duluth. Duluth, Minn., is the nearest port of entry. The collections at this port for the year ending December 31, 1884, were $4,125.63.

Abstract of appropriations made for the harbor of Duluth, Minn., how expended and to be expended, &c.

Appropriations.	Includes examinations, superintendence, contingencies, &c.			Amounts appropriated.
	Construction of breakwater.	Repairs of piers.	Dredging inside harbor.	
By act approved March 3, 1871	$60,000 00			$60,000 00
By act approved June 10, 1872	50,000 00			50,000 00
Allotted from act approved March 3, 1873		$32,723 59	$3,325 61	36,049 20
By act approved June 23, 1874		1,879 54	8,120 46	10,000 00
By act approved March 3, 1875			35,000 00	35,000 00
By act approved August 14, 1876		6,000 00	9,000 00	15,000 00
By act approved June 18, 1878		865 96	29,134 04	30,000 00
By act approved March 3, 1879		4,600 00	20,400 00	25,000 00
By act approved June 14, 1880		5,000 00	20,000 00	25,000 00
By act approved March 3, 1881		5,000 00	35,000 00	40,000 00
By act passed August 2, 1882		4,145 91	40,854 09	45,000 00
By act approved July 5, 1884		*10,000 00	*35,000 00	45,000 00
Total	110,000 00	70,215 00	235,834 20	416,049 20

* These amounts assumed.

Total amount expended to June 30, 1885 (including outstanding liabilities):	
Breakwater	$110,000 00
Canal-piers, &c	64,215 00
Dredging, &c	228,997 40
Total	403,212 40
Amounts expended prior to present project (January, 1881), viz:	
Breakwater	110,000 00
Canal-piers, &c	45,698 33
Dredging, &c	114,953 48
Total	270,651 81
Total amount expended under present project (January, 1881, to June 30, 1885), including outstanding liabilities:	
Canal-piers, &c	18,517 54
Dredging, &c	114,043 05
Total	132,560 59
Estimate for carrying out present project (adopted in 1881)	212,988 36
Increased cost for reasons stated in Annual Report 1884	92,435 64
Total	305,424 00
*Appropriated under present project, to include appropriation July 5, 1884	130,000 00
Remaining to be appropriated	175,424 00

Money statement.

July 1, 1884, amount available		$581 54
Amount appropriated by act approved July 5, 1884		45,000 00
		45,581 54
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$21,510 78	
July 1, 1885, outstanding liabilities	11,233 96	
		32,744 74
July 1, 1885, amount available		12,836 80

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*When the project, 1881, was adopted there was a balance from former appropriations under contract to be completed July 1, 1881.

Amount (estimated) required for completion of existing project	$175,424 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	125,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals opened September 8, 1884, *by Maj. Charles J. Allen, Corps of Engineers, Saint Paul, Minn., for dredging in the inside harbor of Duluth, Minn.*

No.	Names and residences of bidders.	Names and residences of guarantors.	For dredging, per cubic yard.
			Cents.
1	Chicago Dredging and Dock Company, Chicago, Ill.	John Fitley and John P. Gilman, Chicago, Ill.	*20
2	Charles Fitz Simons and Charles J. Connelly, Chicago, Ill.	W. C. D. Grannis and J. J. P. Odell, Chicago, Ill.	21
3	Williams and Upham, Duluth, Minn	Angus R. Macfarlane and George Spencer, Duluth, Minn.	†14
4	Green Bay Dredge and Pile Driver Company, Green Bay, Wis.	Levi P. Godfrey, Joseph Kalb, and Michell Resch, Green Bay, Wis.	16¼
5	Horatio Truman and George Cooper, Manitowoc, Wis.	Reuben D. Smart and Theodore C. Shore, Manitowoc, Wis.	15¼

* Informal; no seal to signatures on guarantee; certificate of justification of guarantors made by a notary public instead of a United States official.

† Contract awarded to Williams and Upham, lowest bidders.

COMMERCIAL STATISTICS, 1884.

Arrivals and clearances of vessels, &c.

Description.	No.	Tonnage.
Arrivals, 1884:		
American vessels from American ports	624	489,078
American vessels from foreign ports	107	13,045
Foreign vessels from foreign ports	157	81,296
Totals:		
1884	888	583,419
1883	796	532,472
1882	833	614,986
1881	666	419,270
1880	524	302,023
1879	502	291,316
1878	406	286,373
1877	329	215,338
Clearances, 1884:		
American vessels for American ports	633	489,865
American vessels for foreign ports	106	11,557
Foreign vessels for foreign ports	164	82,251
Totals:		
1884	903	583,673
1883	779	521,273
1882	832	644,410
1881	660	412,274
1880	524	302,892
1879	497	296,427
1878	348	287,255
1877	328	215,396
Increase in arrivals of all kinds in 1884 over 1883	92	50,947
Increase in clearances of all kinds in 1884 over 1883	124	62,400
Total increase	216	113,347

NOTE.—The "in transit trade" of the port of Duluth for the year ending December 31, 1884, is as follows:

Value of merchandise	$18,365 00
Estimated duties thereon	8,501 34

Receipts and shipments by lake during the year 1884, *at the port of Duluth, Minn.*

Commodities.	Freight received.	Freight shipped.	Total.
	Pounds.	*Pounds.*	*Pounds.*
Coal, salt, railroad and pig iron, bullion, &c	879, 686, 600	68, 862, 800	948, 549, 400
Flour, wheat, and corn, &c	1, 328, 600	787, 500, 000	788, 828, 600
1884	881, 015, 200	856, 362, 800	1, 737, 378, 000
1883	1, 355, 124, 000	497, 446, 000	1, 852, 570, 000
1882	827, 584, 122	322, 634, 840	1, 150, 218, 962
1881	591, 198, 468	347, 667, 727	938, 866, 195
1880	266, 247, 108	368, 386, 251	634, 633, 359
1879	272, 946, 047	316, 917, 673	589, 863, 720
1878	154, 704, 305	199, 052, 477	353, 756, 782
1877	131, 397, 155	165, 753, 224	297, 150, 379
1876	77, 510, 436	192, 676, 050	270, 186, 486

Freight shipments and receipts by railroads at Duluth for the year 1884.

Route.	Shipments.	Receipts.
	Pounds.	*Pounds.*
By Saint Paul and Duluth Railroad	518, 457, 855	632, 193, 282
By Northern Pacific Railroad	268, 063, 570	497, 547, 315
Total	786, 521, 425	1, 129, 740, 597

COMPARISON WITH PREVIOUS YEARS.

Total forwarded and received:	Pounds.
1884	1, 916, 262, 022
1883	1, 716, 854, 956
1882	1, 188, 413, 495
1881	859, 660, 838
1880	769, 680, 497
1879	602, 538, 667
1878	354, 974, 561
1877	311, 208, 341
1876	277, 197, 587

Storms, 1882.

Date.	Direction of wind.	Maximum velocity.	Duration of storm.		Remarks.
		Miles.	*h.*	*m.*	
January 21	NW.	38	3	45	
February 17, 18	NE.	36	12	30	This storm raised a very heavy sea.
March 20, 21	NE.	36	31	00	Very heavy snowfall during the storm, and the sea was heavy, crushing the ice against the piers.
April 8–10	NE.	38	44	00	Heavy sea.
May 9–11	NE.	32	55	00	The sea was terrific. A schooner went ashore on Minnesota Point, but got off without much damage. The sea in the bay was heavy.
June 18	NE.	35	4	00	Very heavy rainfall accompanied this storm. The amount was 2.54 inches.
July 24	W.	42	12	15	This storm was accompanied by a heavy thunderstorm.
August 24	W.	36	0	45	
September 25	NE.	28	3	00	Heavy sea raised.
October 1–3	NE.	40	62	30	Thirteen heavy storms reported for this month. Terrific sea raised by this storm and damage reported.
November 11	NE.	44	12	00	Heavy sea all day. No vessels went out.
December 13	W.	40	5	45	No damage reported from this storm.

Storms, 1883.

Date.	Direction of wind.	Maximum velocity.	Duration of storm.		Remarks.
		Miles.	*h.*	*m.*	
January 10, 11	NW.	56	23	30	
February 16	W.	44	4	30	Heavy snow-storm accompanied this.
March 10	NW.	44	7	00	Fourteen heavy storms from west and northwest this month.
April 21–23	NE.	58	37	45	Very heavy sea created by this storm.
May 17–21	NE.	38	61	30	Very heavy sea. Heavy damages by this storm.
June 29	NW.	36	4	45	Heavy sea in the bay.
July 4	NW.	39	3	45	Do.
August 21, 22	NW.	33	18	00	Do.
September 6	NE.	40	11	35	Heavy damage. Nellie Cotton lost ashore.
September 21	NE.	40	12	35	Heavy seas.
October 5	NE.	28	7	30	Do.

The above table gives the maximum storm for each month.

Storms, 1884.

Date.	Direction of wind.	Maximum velocity.	Duration of storm.		Date.	Direction of wind.	Maximum velocity.	Duration of storm.	
		Miles.	*h.*	*m.*			*Miles.*	*h.*	*m.*
January 2	NW.	36	4	00	June 1	NE.	25	2	15
January 18	NE.	32	10	20	June 12 and 13	NE.	44	36	30
January 19	NW.	26	0	45	June 18	NE.	26	1	55
January 23	NW.	26	3	00	June 24	NE.	46	4	10
January 26	NE.	26	2	15	June 25	NE.	28	4	00
January 27	NE.	28	2	15	July 5	NW.	27	5	15
January 30	W.	27	1	00	July 8	NE.	26	3	50
February 7	NE.	31	8	15	July 17	NE.	30	2	45
February 12	NE.	30	3	15	July 24	NE.	30	1	45
February 17 and 18	NE.	28	31	00	August 1	NE.	28	5	15
February 19	NW.	37	2	05	August 6	N.	26	0	20
February 25	NW.	25	1	45	August 18	NE.	28	6	45
March 2 and 3	NW.	26	3	25	August 20	SW.	28	2	40
March 10 and 11	NE.	40	25	45	September 1	SW.	29	0	25
March 12	W.	26	2	45	September 6	W.	30	1	05
March 12	SW.	26	1	15	September 7	NE.	25	0	40
March 22	NE.	33	11	45	September 8	NE.	36	6	30
March 28	NW.	32	0	50	September 10	NE.	25	0	20
March 29	NE.	26	2	00	September 13	NE.	32	4	15
April 1	NE.	32	8	45	September 16	SW.	25	0	25
April 2	NW.	26	6	10	September 27	NW.	28	0	35
April 6	NE.	31	9	15	September 30	NE.	41	2	15
April 7	NE.	34	7	30	October 1 and 2	NE.	46	32	00
April 12	NE.	35	1	45	October 5	SW.	32	3	15
April 14 and 15	NE.	50	20	00	October 5	NE.	32	5	30
April 15	NW.	28	2	15	October 16	W.	25	0	25
April 19	NW.	34	7	25	October 20	NE.	28	1	45
April 20	NE.	28	2	15	November 16	NW.	32	2	50
April 27	NW.	36	3	30	November 20	NW.	25	0	20
April 29	NE.	48	20	00	November 21	NW.	28	0	25
May 8	NW.	32	5	40	November 22	NE.	39	3	35
May 13	NW.	28	2	20	November 22 and 23	NW.	44	9	30
May 18	NW.	31	4	30	November 25	W.	28	0	45
May 21	NE.	39	10	00	December 15	NW.	30	1	55
May 27	NE.	40	15	45	December 22	NW.	33	6	10
May 30	W.	28	3	50	December 24	NW.	29	2	35
May 31	NE.	30	4	15	December 31	NW.	42	12	05

Opening and closing the harbor at Duluth, Minn.

Year.	Opening.	Closing.	Year.	Opening.	Closing.
1855	Apr. 15	Dec. 16	1870	Apr. 12	Nov. 21
1856	Apr. 16	Nov. 22	1871	Apr. 5	Dec. 6
1857	May 27	Nov. 20	1872	Mar. 9	Nov. 24
1858	Mar. 20	Nov. 20	1873	May 10	Dec. 30
1859	May 25	Nov. 9	1874	May 2	Dec. 11
1860	Apr. 7	Dec. 4	1875	May 12	Dec. 10
1861	June 12	Dec. 12	1876	May 2	Dec. 19
1862	Apr. 28	Dec. 16	1877	Apr. 25	Dec. 17
1863	May 10	Dec. 7	1878	Mar. 23	Jan. 2*
1864	Apr. 23	Dec. 1	1879	Apr. 17	Dec. 12
1865	Apr. 22	Dec. 5	1880	May 1	Dec. 17
1866	May 5	Dec. 10	1881	May 8	Nov. 26
1867	Apr. 19	Dec. 1	1882	Apr. 15	Dec. 30
1868	Apr. 1	Nov. 21	1883	Apr. 9	Dec. 24
1869	Apr. 25	Nov. 12	1884	May 1	Dec. 25

* 1879.

LETTER FROM COMMITTEE CHAMBER OF COMMERCE, DULUTH, MINNESOTA.

DULUTH, MINN., *April* 16, 1885.

DEAR SIR: The undersigned, a committee of the Chamber of Commerce of Duluth, appointed to consider the matter of harbor improvements, beg leave respectfully to recommend and request, in behalf of the chamber of commerce and citizens of Duluth, that whatever money may be available for improvements in the harbor of Duluth for the current year be expended, first, in removing any bars that may have formed in the dredged portion of the harbor; and, second, in enlarging the basin of the harbor so as to give more room for vessels to ride at anchor, and respectfully submit the following as reasons for such recommendation:

First. Our commerce during the last season increased to such an extent that vessels were not unfrequently obliged to wait for an opportunity to unload at the docks and to load at the elevators and in the mean time to ride at anchor in the basin. At one time during the last season there were thirty-two vessels in the harbor. The large amount of grain in our elevators and the large amount of ore being mined by the Minnesota Iron Company for shipment east lead us to confidently expect a large increase in the number of vessels entering our harbor this season over the last.

Second. Our harbor is essentially a harbor of refuge, and the only one accessible within 80 miles on the south shore, and the only one on the north shore; and it seems to us necessary that the basin of our harbor should be so enlarged that fleets of vessels bound eastward or westward may in a storm run into our harbor and come to an anchor without fear of colliding with other vessels. In the past season we have seen the necessity of this, as on some occasions in northeast storms as many as twenty-nine vessels in one night have made our harbor for safe shelter, and with the increase of the commerce on Lake Superior such instances will be more frequent, and we should provide for such emergency.

Third. We do not deem it advisable that any money should be expended the present season in dredging a channel along the east side of Rice's Point, because there is no such immediate urgent necessity for this as for the enlargement of the basin, and because we are very desirous of securing a change of the dock line along the east side of Rice's Point before any money is expended on that channel; and it is our purpose to procure legislation at the next session of Congress authorizing such change, with the consent of the Secretary of War and Engineer Department.

Hoping our recommendations may meet your approval, we are, major,

Very respectfully, your obedient servants,

O. P. STEARNS.
J. D. ENSIGN.
S. MENDENHALL.
ALEX. MCDOUGALL.
WM. W. BILLSON.

Maj. CHAS. J. ALLEN,
United States Engineer.

G G 2.

DREDGING SUPERIOR BAY, WISCONSIN.

The present plan of improvement is based upon the report of a Board of Engineers convened in January, 1881, and contemplates—

(1) Deepening and enlarging the channel between the piers at the entry.

(2) Dredging a channel from the entry past the mouth of the Nemadji River around and parallel to the shore of Superior Bay to Quebec Wharf.

(3) Thence from Quebec Wharf along the west side of the bay to an intersection with the channel of the Saint Louis River opposite Connor's Point.

(4) Up the Nemadji River for about half a mile.

The preservation, by deepening and enlarging, of the old Quebec Wharf Channel was afterwards added.

The dredging to provide for vessels drawing 16 feet.

The cost of the preservation of the piers at the entry placed at $25,000.

Total estimated cost, $312,080.

For the history of the work for improvements in the Bay of Superior to close of fiscal year ending June 30, 1879, see pages 1470, 1475, Appendix Y, Annual Report 1879.

For account of improvements since 1879 see annual reports to date.

The river and harbor act of Congress approved July 5, 1884, appropriated for "Improving Superior Bay and Harbor, Wisconsin, and also the channel of the Saint Louis River through said bay, forty-five thousand dollars." This sum was applied to dredging and maintenance of piers bordering the entry. A contract for dredging was entered into with Williams & Upham, September 19, 1884, to be completed by September 1, 1885. Under this contract 152,788 cubic yards of material were removed from the channels during the fiscal year.

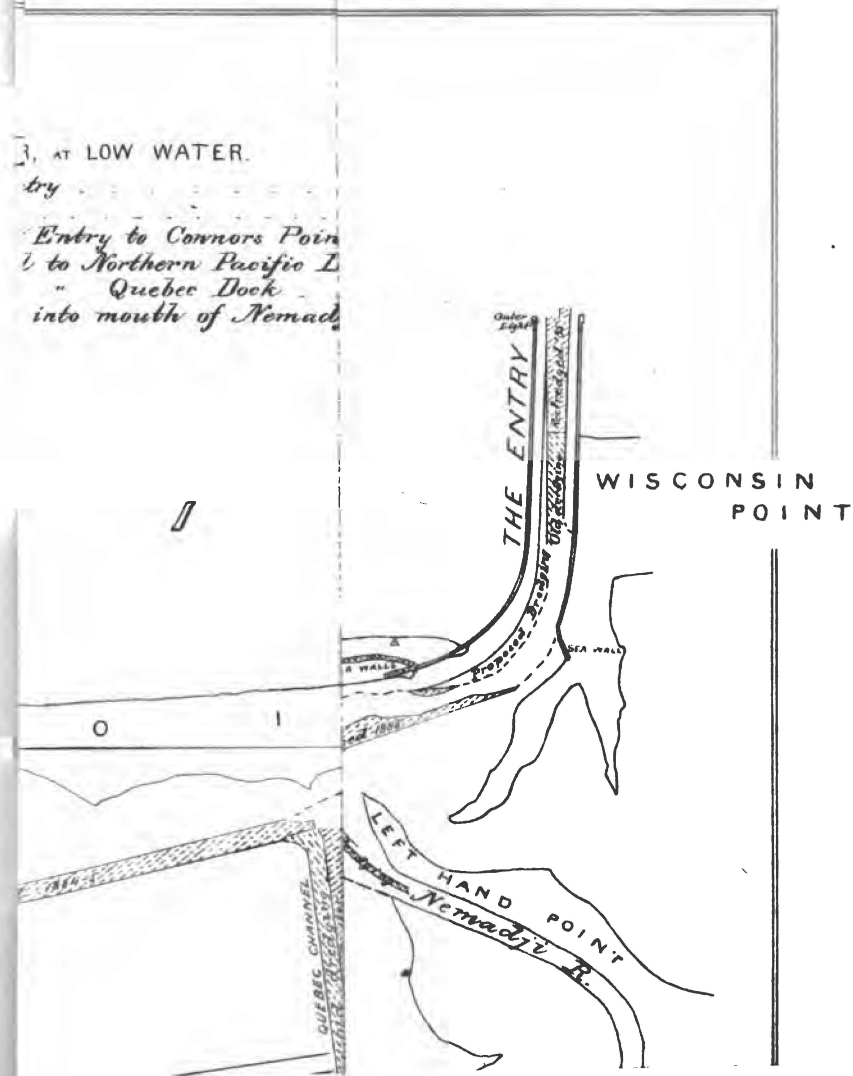
Eight hundred and sixty-seven linear feet of the south pier, measuring from the lake end of pier, were repaired and in great part renewed above the water-line, and some slight repairs made to the north pier and to the sand fence at The Opening. There were expended in this work, which was performed by day labor—

Lumber, feet, B. M	205,061
Cedar posts	20
Rock filling, cords of	267.53
Brush filling, cords of	17
Drift bolts and spikes, pounds of	12,771

These repairs were economically made by Assistant Engineer Guy Wells, and completed in November, 1884.

Thorough soundings, taken over large areas of the harbor during the fall of 1884, for comparison with those of the survey of 1879, showed that more or less of scour and fill had taken place within the entire harbor during the five years. On account of this movement of material it is necessary, in calculations for improvement, to provide for more or less redredging of areas for some years to come.

The piers are now in good condition. A reserve of funds should, however, be available with which to make such repairs as may be ren-



R, AT LOW WATER.
try
Entry to Connors Poin
to Northern Pacific D
" Quebec Dock
into mouth of Nemadj
Outer Light
THE ENTRY
Proposed Dredging
Old Dredging
Redredged
WISCONSIN POINT
SEA WALL
SEA WALL
O I
1884
QUEBEC CHANNEL
LEFT HAND POINT
Nemadji R.

dered necessary by the effects of northeast storms. Following are the ruling depths in channels:

	Feet.
On lake approach to entry	17
In entry, between the piers	16
In Saint Louis River Channel, from the entry to Connor's Point	16
From Saint Louis River Channel to Northern Pacific Dock	17
In front of Quebec Dock	12
From main channel, near the entry, across the bar, into the Nemadji River	7

All these channels require widening.

The dredging and examinations of the harbor have been in charge of Mr. J. H. Darling, assistant engineer, assisted by Messrs. W. B. Silvey and W. C. Howenstine, to all of whom credit is due for faithful and zealous work.

If the recommendation of the officer in charge of the Saint Mary's Falls Canal be carried out, viz, the construction of a new lock to afford a depth of 21 feet on the miter-sill, the channels in Superior Harbor and Bay must be eventually deepened accordingly.

The necessity of protecting Minnesota Point against erosion has been referred to in preceding reports.

Before improvement began in 1881, under the present project, the ruling depth in the entry, and thence to Quebec Wharf, was 11 feet; and, before work of improvement began in 1867, the ruling depth through a tortuous and difficult channel across the bar was about 8 feet.

Amount expended under appropriations prior to adoption of the present plan (January, 1881)	$335,513 26
Amount expended to June 30, 1885 (including outstanding liabilities), under original and present plan	425,373 73
Amount expended under present plan to June 30, 1885 (including outstanding liabilities)	89,860 47
Estimated cost of present project	345,080 00

In pursuance of the present plan, the sum of $50,000 can be profitably expended during the fiscal year ending June 30, 1887, in dredging, maintaining the piers, and in beach protection. The balance from appropriations, available at the close of the fiscal year 1885, will be expended in completion of the dredging contract and in maintenance of piers.

The act of Congress July 5, 1884, having added to the channels to be improved the channel of the Saint Louis River, within the Bay of Superior, the cost of improvement is thereby increased by $33,000, bringing the total estimate of cost up to $345,080.

Abstract of appropriations made for improving Superior Harbor, Wisconsin; how expended, and to be expended, &c.

Appropriations.	Includes superintendence, examinations, contingencies, &c.			Amounts appropriated.
	For repairs and beach protection.	Expended and to be expended in construction and repairs of piers.	Expended and to be expended in dredging.	
By act approved March 3, 1867	....	$63,000 00	....	$63,000 00
By act approved April 10, 1869	....	45,000 00	....	45,000 00
By act approved July 7, 1870	....	40,000 00	....	40,000 00
By act approved March 3, 1871	....	60,000 00	....	60,000 00
By act approved June 10, 1872	....	50,000 00	....	50,000 00
Allotted from act approved March 3, 1873	....	41,322 64	*$22,628 16	63,950 80
Allotted from appropriation repairs of harbors on Northern Lakes	$5,433 00	....	....	5,433 00
By act approved August 14, 1876	†3,000 00	....	....	†3,000 00
By act approved June 18, 1878	†3,000 00	....	....	†3,000 00
By act approved March 3, 1879	....	5,000 00	....	5,000 00
By act approved June 14, 1880	....	5,000 00	....	5,000 00
By act approved March 3, 1881	....	....	‡10,000 00	‡10,000 00
By act passed August 2, 1882	§1,800 00	8,200 00	‖35,000 00	40,000 00
By act approved July 5, 1884	....	¶ 10,000 00	¶ 35,000 00	45,000 00
Total	13,233 00	322,522 64	102,628 16	438,383 80

---

* Of this amount there was expended in dredging between the piers at the natural entry the sum of $3,397.95, and in dredging from the entry channel to the wharves of Superior City the sum of $19.230.21.

† Of these amounts there was expended during June and July, 1879, in dredging in the Bay of Superior, on a line connecting the harbors of Duluth and Superior, the sum of $2,000. These amounts were not included in the original estimates.

‡ This amount was expended in dredging in the Bay of Superior, between the piers at the entry, along a line leading from the entry into and up the Nemadji River, and in the Quebec Wharf Channel and vicinity, between the piers, about $1,800, otherwise, about $8,200.

§ This amount was expended in the fall of 1882 in protecting the breach in Minnesota Point, known as the "opening."

‖ This amount was expended in dredging between the piers at the entry and in the Quebec and Northern Pacific Wharf Channels and vicinity, and in removing shoals between the piers, &c.

¶ These amounts are assumed, expended, and to be expended in repairs and maintenance of piers, &c., dredging in the entry between the piers, in the Quebec and main channels, &c.

Money statement.

July 1, 1884, amount available		$4,023 09
Amount appropriated by act approved July 5, 1884		45,000 00
		49,023 09
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$26,889 51	
July 1, 1885, outstanding liabilities	9,123 51	
		36,013 02
July 1, 1885, amount available		13,010 07

Amount (estimated) required for completion of existing project	250,080 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals opened September 8, 1884, by Maj. Charles J. Allen, Corps of Engineers, Saint Paul, Minn., for dredging in the Bay of Superior and in the Saint Louis River Channel, within Superior Bay, Wisconsin.

No.	Names and residences of bidders.	Names and residences of guarantors.	For dredging, per cubic yard.
			Cents.
*1	Chicago Dredging and Dock Company, Chicago, Ill.	John Filley and George P. Gillman, Chicago, Ill.	20
2	Charles Fitzsimmons and Charles J. Connell, Chicago, Ill.	W. C. D. Grannis and J. J. P. Odell, Chicago, Ill.	21
†3	Williams & Upham, Duluth, Minn	Angus R. Macfarlane and George Spencer, Duluth, Minn.	15
4	Green Bay Dredge and Pile Driver Company, Green Bay, Wis.	Levi P. Godfrey, Joseph Kalb, and Michell Resch, Green Bay, Wis.	16
5	Horatio Truman and George Cooper, Manitowoc, Wis.	Reuben D. Smart and Theodore C. Shore, Manitowoc, Wis.	16½

* Informal; certificate of justification of guarantors made by a notary public instead of a United States official.

† Contract awarded to Williams & Upham, lowest bidders.

COMMERCIAL STATISTICS, 1884.

Under date of February 24, 1885, the collector of customs at Marquette, Mich., writes in regard to Superior City Harbor:

Referring to your letter of the 7th instant, relative to statistics of this district for the year ending December 31, 1884, I have the honor to submit the following report:

Total revenues collected at the port of Superior, Wis., during the year ending December 31, 1884	$57 89
Amount of revenue collected at Marquette, Mich., during the year ending December 31, 1884	15,535 51

Superior is in the collection district of Superior, and Marquette is the port of entry.

Arrivals and clearances of vessels, American and foreign, at port of Superior, during the year 1884.

Class.	Number.	Tons.
Screw steamers	46	32,883
Paddle steamers	2	418
Sailing vessels	49	24,635
Total	97	57,936

Merchandise received by lake at port of Superior during the year 1884.

Articles.	Quantity.	Value.
Coal ... tons	83,840	$462,271
Railroad iron ... do	490	13,280
Shingle-bolts ... cords	80	400
Total		475,901

Merchandise shipped by lake from port of Superior during the year 1884.

Articles.	Quantity.	Value.
Shingles	180,000	$450
Brick	50,000	500
Lumber	763,000	7,544
Total		8,494

LETTER OF MR. JAMES BARDON.

SUPERIOR, WIS., *May* 15, 1885.

DEAR SIR: The following in general terms and round numbers is a statement of the trade and commerce of Superior for the year 1884:

IMPORTS.

* * * * * * *

Total $1,800,000

EXPORTS.

* * * * * * *

Total $3,015,000

The imports and exports added together make a total trade of $4,815,000 handled at the port of Superior during the year 1884. As Superior is the distributing point for a large extent of country, the town is necessarily credited with some articles twice, coming in and going out. The railroad iron received was for the Northern Pacific and the Chicago, Saint Paul, Minneapolis and Omaha Railways.

The coal very nearly all came for one concern, the Saint Paul and Pacific Coal and Iron Company, over their large dock on Connor's Point, at which, during the season, there were eighty-one arrivals of vessels, sail and steam, many of them of the largest draught plying on the lakes, bringing a total of 80,000 tons.

The cattle enumerated were shipped to Superior from Wyoming Territory by the Powder River Cattle Company, and were wintered here in large sheds built for that purpose. The complete success of this experiment of shipping cattle from the Western plains to Superior, feeding them here and making this the point of distribution to the Eastern markets, via the lakes, marks a new era in the cattle trade of the United States, and may result in making Superior a great cattle market.

One of the strongest points in favor of the route through Superior and eastward, via the lakes, is that this route is north of the line of pleuro-pneumonia; that cattle are kept free from contamination with infected animals from the South and Southwest and landed in the Eastern cities and in England in perfectly healthy condition. Many Western stockmen are proposing to establish yards here, and the handling and shipment of live cattle at Superior promises to grow to large proportions in the next year or two.

Since my last report the new town of West Superior has sprung into existence. Its plat adjoins that of the original town of Superior, although between 2 and 3 miles intervene between the business centers of each. The first building was erected in August last, and to-day there is a brisk town there, with a population of not less than 600. The place fronts on Superior Harbor, immediately north of Superior, and on Saint Louis Bay, west of Connor's Point. It bids fair to become a leading railroad and shipping point.

The railroad bridge constructed across the Saint Louis River the past winter starts from the Wisconsin shore at West Supesior.

Several coal companies have secured frontages on the harbor at Superior and West Superior, and propose to build coal docks this year. On Detroit Pier, at Superior, midway between the Northern Pacific Railway Company's dock and Quebec Pier, a dock is to be built this year for handling coal and cattle. An approach to this dock has just been contracted for at a cost of $3,000.

A flouring mill of 200 barrels per day capacity has just been erected on the Bay of Superior, at Connor's Point.

There are now two important railway lines completed at Superior, the Northern Pacific, and the Chicago, Saint Paul, Minneapolis and Omaha. The Saint Paul, Minneapolis and Manitoba, it is expected, will soon build its projected Saint Cloud line from Hinckley to Superior, and the Chicago, Milwaukee and Saint Paul Railway system will reach Superior from Chippewa Falls before the close of the year, through the medium of the Superior, Hayward and Southern Railway.

Altogether the outlook for a great business at the harbor of Superior was never brighter. It is to be hoped that the next Congress will make a liberal appropriation for its improvement. It is the harbor and shipping point not only for Wisconsin and Minnesota, but also for Nebraska, Dakota, Colorado, Wyoming, and Montana.

Very respectfully,

JAMES BARDON.

Maj. CHAS. J. ALLEN,
U. S. Engineer.

G G 3.

IMPROVEMENT OF HARBOR AT GRAND MARAIS, MINNESOTA.

The project for the improvement of this harbor, adopted in 1879 and continued since that time, provided for a breakwater and for dredging within the area bounded by Mayhew's Point and the inner shore line to afford anchorage for vessels drawing 16 feet. The breakwater, 350 feet in length, jutting out from the westerly end of Mayhew's Point, was completed in 1883. Should it become necessary to enlarge the area of shelter, such enlargement can be effected by extending the breakwater westerly or by constructing a branch from its westerly end to extend into the bay in a direction a little west of north.

The work during the past fiscal year for the improvement of this harbor consisted in dredging and in slight repairs to the breakwater. The latter consisted in refilling some of the crib-pockets with stone and a small proportion of brush, and in facing the seaward side of the breakwater with 6-inch plank drift-bolted on vertically to protect the structure against grinding action of ice. In the repairs, made by hired labor and purchase of materials in open market, there were consumed—

Rock-filling, cords of	21,615
Drift-bolts, pounds	4,800
Lumber, feet, B. M	11,738

Under the appropriation by act of Congress approved July 5, 1884, a contract for dredging was entered into September 19, 1884, with Williams & Upham, of Duluth, Minn. The work of dredging commenced in September, and was finished in November, 1884. Total quantity of material excavated and removed, 31,625 cubic yards.

Before the work of improvement commenced there was but a narrow space under the lee of Mayhew's Point for vessels of 10 feet depth seeking refuge during storms. There is now a sheltered area behind the point and breakwater of about eight acres, with depth of 16 feet. During the season of 1884 numbers of vessels made the harbor, and it is reported that on one occasion eleven vessels of various sizes occupied the harbor in order to ride out a storm.

The harbor area should be largely increased by dredging. This is the only harbor of refuge on the north shore of Lake Superior.

Amount expended since adoption of the original (which is the present) project to June 30, 1885	$67,506 13
Estimated cost of the original project	139,669 40

The sum of $40,000 can be profitably expended during the fiscal year ending June 30, 1887, in dredging and in maintenance of the breakwater.

The balance of funds available from appropriations to date will be applied to maintenance of the breakwater and contingencies.

Mr. Randell Hunt, inspector of work during the season of 1884, is entitled to credit for intelligent management of the dredging.

This work is in the collection district of Duluth. Duluth, Minn., is the nearest port of entry, at which place the revenue collected during the year ending December 31, 1884, amounted to $4,125.63.

ABSTRACT OF APPROPRIATIONS MADE FOR IMPROVING HARBOR AT GRAND MARAIS, COOK COUNTY, MINNESOTA.

By act approved March 3, 1879	$10,000
By act approved June 14, 1880	10,000
By act approved March 3, 1881	20,000
By act passed August 2, 1882	20,000
By act approved July 5, 1884	10,000
Total	70,000

Money statement.

July 1, 1884, amount available	$2,716 70
Amount appropriated by act approved July 5, 1884	10,000 00
	12,716 70
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	10,222 83
July 1, 1885, amount available	2,493 87
Amount (estimated) required for completion of existing project	69,669 40
Amount that can be profitably expended in fiscal year ending June 30, 1887	40,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of a proposal opened September 8, 1884, *by Maj. Charles J. Allen, Corps of Engineers, Saint Paul, Minn., for dredging in the harbor of Grand Marais, Cook County, Minnesota, on the north shore of Lake Superior, about* 160 *miles northeast of Duluth, Minn.*

No.	Names and residence of bidders.	Names and residence of guarantors.	For dredging per cubic yard.	Remarks.
			Cents.	
1	Williams & Upham, Duluth, Minn.	Angus R. Macfarlane and George Spencer, Duluth, Minn.	25	Contract awarded to Williams & Upham.

COMMERCIAL STATISTICS, YEAR 1884.

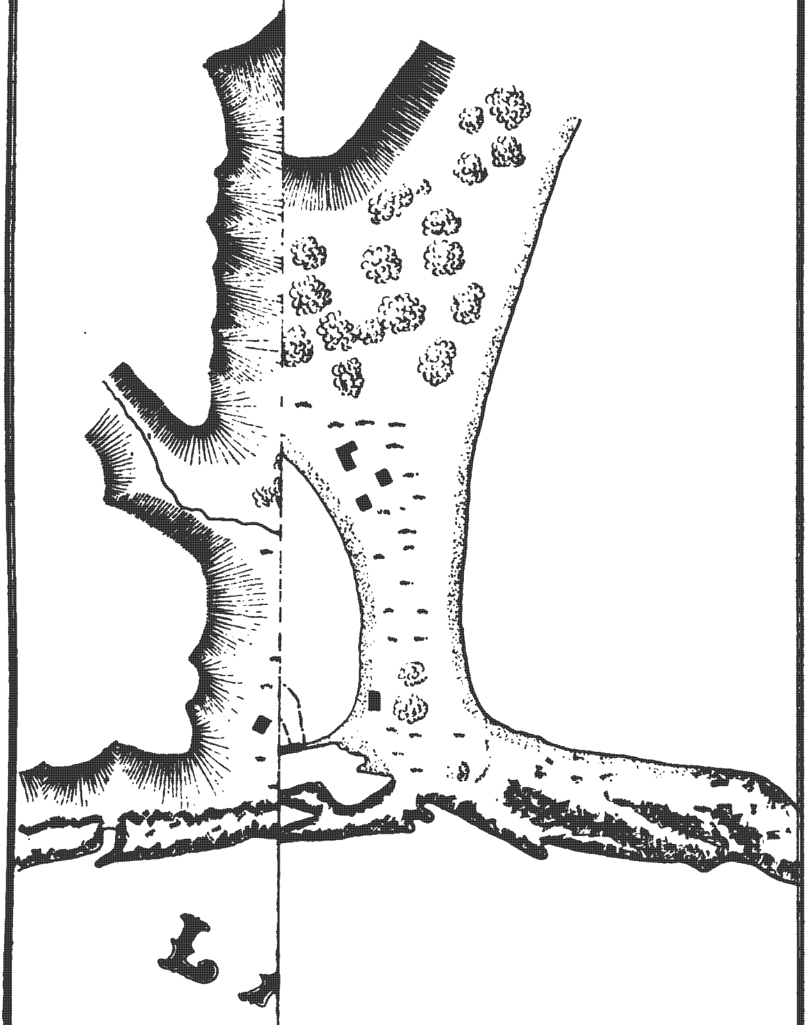
Arrivals and clearances of vessels.

Description.	Vessels.	Screw-steamers.
ARRIVALS.		
American vessels from American ports	3	76
American vessels from foreign ports		66
Foreign vessels from foreign ports	2	5
CLEARANCES.		
American vessels for American ports		82
American vessels for foreign ports		69
Foreign vessels for foreign ports	2	
Foreign vessels for American ports		5

Casualties on the north shore of Lake Superior, 1872 *to* 1884.

Name of vessel.	Where loss occurred.	Date of loss.	Class of vessel.	Tonnage.	No. of lives lost.	Loss to vessel.	Loss to cargo.
You Tell *	Grace Harbor	Sept. 27, 1872	Scow	150		$2,500	$600
Lottie Barnard †	Agate Bay	1876	Steamer	90	2	6,000	500
Charlie ‡	Grand Marais	1877	Schooner	75		2,000	200
Cumberland *	Rock of Ages	Aug., 1878	Propeller	1,000		100,000	1,000
Stranger †	Off Grand Marais	Nov., 1875	Schooner	15	4	800	800
Siskowit ‡	Near Little Marais	Nov., 1879	Tug	37		2,000	500
Amethyst ‡	do	Nov., 1879	do	18	1	1,000	
Quebec §	Off Grand Marais	Oct. 17, 1880	Propeller	1,300			6,000
Siskowit ‖	do	Nov., 1880	Tug	37		300	
Siskowit ¶	Lester River	June 23, 1882	do	37		400	

* Total wreck.
† Sunk.
‡ Went ashore.
§ Washed overboard.
‖ Broken wheel.
¶ Ran on the beach and upset.



pany Major C.J. ALLEN'S Report
ions for year ending June 30, 1885.

ging to afford depth of 16 feet.

H Ex1 pt2 v2 49 1

FREIGHT RECEIVED AND SHIPPED.

	Value.
Freight received:	
204,982 pounds of general merchandise	$22,840 37
Freight shipped:	
785 pounds of fur	3,907 61
40,902 pounds of fresh fish	1,227 06
17,190 pounds of salt fish	648 72
1,400 pounds of sundries	1,575 00

LETTER OF MR. T. W. MAYHEW.

GRAND MARAIS, MINN., *March* 25, 1885.

SIR: Herewith please find inclosed report of commercial statistics of Grand Marais Harbor for the year 1884. In connection with the above report, I would say that an early construction of the Grand Marais and Vermillion Railroad is contemplated. I have reason to expect that the work will be commenced early this spring. The line of the projected road will run from Grand Marais, through the iron deposits, to Vermillion, and also a branch road, to accommodate the gold and silver locations, will probably be constructed, running northeast to the boundary line. All of the land containing mineral deposits has been purchased by capitalists, who propose commencing operations as soon as the lake navigation opens. The general indications seem to predict increased business, and a rapid development of the mineral resources of the country.

Yours, very respectfully,

T. W. MAYHEW.

Maj. CHAS. J. ALLEN, U. S. A.

G G 4.

PRELIMINARY EXAMINATION OF BIG STONE LAKE AND LAKE TRAVERSE, MINNESOTA, WITH A VIEW TO CONNECTING THEM.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., October 20, 1884.

GENERAL: I have the honor to submit the following report of a preliminary examination of Big Stone Lake and Lake Traverse, Minnesota, made in compliance with the requirements of section 9, river and harbor act of Congress, approved July 5, 1884.

Big Stone Lake is about 25 miles long and from one-half a mile to 1 mile in width, being, in fact, an enlargement of the channel of the Minnesota River and near the sources of that stream. It is separated from Lake Traverse by a strip of land about 5 miles in width. The difference in elevation, at low water, between the lakes, as ascertained by the survey of 1873, is 7.2 feet, Lake Traverse being at the higher elevation. During times of extraordinarily high water small boats have passed from one lake to the other.

Lake Traverse is part lake and part marsh, is about 30 miles long, and from 1 mile to 4 miles broad. This lake is at the head of the Bois de Sioux, a stream uniting with the Otter Tail River at Breckenridge, the two forming the Red River of the North. The distance by river from Lake Traverse to Breckenridge is about 90 miles; from Breckenridge to McCauleyville, the head of navigation on the Red River, the distance by river is about 25 miles. At extreme low water there is no discharge from Lake Traverse, the bed for many miles below it consisting of a series of pools separated by mud-bars. Between Breckenridge and McCauleyville portions of the river are much obstructed by snags, bowlders, mud-bars, and, in many places, rapids.

The Minnesota River below Big Stone Lake, until joined by the waters of the Pomme de Terre and Chippewa rivers, is a small creek, varying in width from 15 feet to 125 feet. The volume of discharge at low water is small, and the bed has been known several times to be perfectly dry in places. It is, however, subject to heavy floods in spring, a rise of 17 feet not being unusual, the duration of the flood seldom exceeding two weeks. The distance from Big Stone Lake to the Yellow Medicine River, one of the tributaries of the Minnesota below the lake, is about 95 miles, the fall in that distance being about 118 feet. The river below Yellow Medicine is navigable or not, according to the stage of water. So far as can be learned there is no attempt at present to navigate this portion of the river.

The following are the statistics of the region tributary to the two lakes, as far as could be ascertained by Assistant Davenport, who was directed to make the examination:

Population:	
Ortonville	1,500
Big Stone	1,000
Brown's Valley	500
Territory immediately tributary to Big Stone Lake and Lake Traverse	7,500

Territory tributary to Big Stone Lake and Lake Traverse, 1,252,000 acres, three-fourths of which is claimed to be good wheat land, capable of producing twenty bushels of wheat per acre; the remaining one-fourth, meadow land. It is estimated that one-eighth of this area is now under cultivation.

Freight receipts and shipments.

FREIGHT RECEIVED.

Ortonville, freight received, one year	pounds	68,418,816
Brown's Valley, freight received, one year	do	18,662,660

SHIPMENTS.

Merchandise:		
Ortonville, one year	pounds	22,679,500
Brown's Valley, one year	do	5,498,115
Wheat:		
Ortonville, one year	bushels	750,000
Brown's Valley, one year	do	700,000

Assistant Davenport experienced difficulty in procuring statistical information from parties who were in positions to enable them to give it, notwithstanding that they expressed great interest in the improvement under consideration and had promised him such information.

A communication was received this morning from citizens of Big Stone, a copy of which is herewith, stating the advantages that would accrue to that locality were the lakes connected with the Red River of the North, amongst which was an estimated possible saving annually to the wheat producers alone of $120,000.

The Fargo and Southern Railway, said to be a part of the Chicago, Milwaukee and Saint Paul Railway system, crosses the Bois de Sioux near the northern end of Lake Traverse.

A branch of the Chicago, Milwaukee and Saint Paul Railway passes through Ortonville at the southerly end of Big Stone Lake, and a branch of the Saint Paul, Minneapolis and Manitoba Railway runs to Brown's Valley between the two lakes.

To return to the act of Congress ordering the examination: It requires an examination of "Big Stone Lake and Lake Traverse, with a view to connecting them." Nothing is said in the act about any further improvement upon or connection with the lakes. The connection between the lakes would have to be by means of a canal and lock, and with proper lake approaches, &c., constructed at great expense, probably, including damages, $400,000. The connection might result in securing competition between two railroads. But the improvement of the Minnesota River from the outlet of Big Stone Lake to its junction with the Mississippi would be necessary for the products of the country under consideration to reach their markets independently of railroads; and the improvement of the Bois de Sioux and Red River to Breckenridge, at heavy cost, so as to afford egress from the lakes in that direction, would, it seems to me, be simply bringing the products to the same railroads that now tap the country adjoining the lakes. (Please see tracing* herewith.)

Section 9 of the act of Congress approved July 5, 1884, provides—

> That no survey shall be made of any harbors or rivers until the Chief of Engineers shall have directed a preliminary examination of the same by the local engineer in charge of the district, or an engineer detailed for the purpose; and such local or detailed engineer shall report to said Chief of Engineers whether, in his opinion, said river or harbor is worthy of improvement, &c.

It does not appear to me that the advantage to the public consequent upon connecting Big Stone Lake and Lake Traverse would be by any means proportional to the expense involved in making and maintaining the connection, and I am, therefore, decidedly of opinion that the work or improvement proposed should not be classed with improvements worthy of being undertaken by the General Government.

Very respectfully, your obedient servant,

CHAS J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

COMMUNICATION OF CITIZENS OF BIG STONE CITY, DAKOTA.

We, the undersigned committee appointed to ascertain and report to the citizens of Big Stone City, Grant County, Dakota, statistics and estimates of the territory tributary to Big Stone Lake from Grant County and Roberts County, in the Territory of Dakota, and the advantages accruing to said Territory, in the event of navigation being opened from Big Stone Lake to the Red River, would respectfully submit the following:

That the farming land tributary to the west side of Big Stone Lake, which would include a strip of land 50 miles long and 20 miles wide, to wit, between the lake and the Dacotah Hills, has at present a population of 8,000, and takes in the towns of Big Stone City, Geneva, and Travare, on the lake, and Milbank and Wilmot, within 10 miles of the lake.

The above-mentioned area comprises 640,000 acres of good tillable land, about one-half of which is at present under cultivation. Estimating 200,000 acres sown to wheat at an average of 20 bushels to the acre, we would have 4,000,000 bushels of wheat, which would all be marketed on said lake in case wheat could be shipped to advantage north.

If the farmers in said territory could realize a saving of say 3 cents per bushel in freight by reason of the water transportation referred to, it would be a saving, or actual profit, to them of $120,000 per year on wheat alone.

And supposing the profits on all other products raised in said area to be equal to one-quarter of that amount, there would be a saving of $30,000 more, making a total saving on agricultural products of $150,000 in one year.

At present we have at the foot of the lake water-power "roller mills" with a capacity of 250 to 300 barrels per day, and we believe that there is further power that will be developed for mills and manufactories, the products of which would be shipped by way of the lake north at a like saving.

---

*Omitted.

We would submit that with the advantage of such a water-route the saving to the farming community in the above-mentioned area on their products alone would in one year amount to as much as the cost of opening up the same.

If such a vast array of figures is necessary to indicate the present wealth of the region immediately tributary to the water-way, what will it not be in a short time, as it increases from year to year in population?

The project of opening up this water-way from Big Stone Lake to the Red River seems to your committee so feasible and ultimately necessary that it would be almost impossible to estimate fully the advantages and benefits to the country adjacent thereto.

And our committee would urge the keeping of the project and its advantages before our legislature and the Congress of the United States through the proper officials at all times.

HENRY NEILL,
R. W. MORRIS,
E. M. BENNETT,
JACKSON BUHLER,
D. W. FOUNTAIN,
H. J. MCGIVEN,
R. W. RESSEGUIRE,
Committee.

BIG STONE CITY, GRANT COUNTY, DAKOTA, *October* 8, 1884.

G G 5.

PRELIMINARY EXAMINATION OF AGATE AND BURLINGTON BAYS, MINNESOTA.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., October 8, 1884.

GENERAL: I have the honor to submit the following report of a preliminary examination made in September last at "Agate and Burlington bays," Minnesota, in accordance with the requirements of section 9 of the river and harbor act of Congress, approved July 5, 1884.

Agate and Burlington bays are on the north shore of Lake Superior and distant from Duluth about 27 miles. The bays are separated from each other by a headland, Burlington Bay being the more easterly of the two. The locality is now known as Two Harbors. Agate Bay is 3,600 feet wide at its entrance, and extends into the shore about 2,100 feet; Burlington Bay is 5,400 feet wide, extending into the shore about 2,800 feet. Both bays are generally deep, the depths of water ranging from 10 feet to 60 feet, the greatest depths being at the entrances. The bays are open to the south and more or less exposed to waves from the southwest, southeast, and east also.

The following extract from the report of Assistant J. B. Parkinson shows the present commerce of the place (Two Harbors), and also gives an idea of its prospective commerce:

> From opening of navigation to September 1, 1884, merchandise, 5,800 tons; August 19 (first shipment) to September 18, iron ore, 21,933 tons; from opening of navigation to August 19, lower lake steamers, 8; from opening of navigation to August 19, Duluth steamers, 2 daily; from opening of navigation to August 19, numerous north-shore boats; from August 19 to September 18, 73 vessels of all kinds.
>
> The Duluth and Iron Range Railroad was only opened for business August 11, so that only a very partial showing as to the probable business for next season is given by the foregoing figures. The railroad company have built an ore dock 600 feet by 32 feet and have the piling and foundation in place for another dock of the same size as the first and parallel to it, forming a slip 125 wide between them. They have also built a double merchandise dock, each side being 50 feet wide with a slip 100 feet in width between them. The length of this dock is about 400 feet. The railroad company are said to own between 400 and 500 cars and expect to do a large business the coming season.

I would add to the foregoing statistics obtained by Assistant Parkinson in September last that, with the exception of the partly finished harbor at Grand Marais, Minn., about 110 miles from Duluth, there is no harbor on the north shore of Lake Superior between Duluth and Canada where vessels can seek shelter when storms threaten, so that an improvement at Agate and Burlington bays would add to the safety of north-shore vessels.

In view of the present and prospective commerce of Agate and Burlington bays, I am of opinion that they are worthy of improvement.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

SURVEY OF AGATE AND BURLINGTON BAYS, MINNESOTA.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., January 5, 1885.

GENERAL: I have the honor to submit the following report of a survey in detail of Agate and Burlington bays, Minnesota, made in accordance with the provisions of section 9 of the river and harbor act of Congress approved July 5, 1884:

Agate Bay is on the north shore of Lake Superior, and distant from Duluth about 27 miles. Burlington Bay is immediately east of Agate Bay. The locality is known as Two Harbors.

By reference to the map* herewith, it will be seen that the lengths of the bays are great as compared with their widths, and that the depths of water increase very rapidly from the shore, reaching 40 and 50 feet at short distances from shore.

Agate Bay is exposed to storms from the southwest, south, and southeast, the "fetch" or sweep of sea not exceeding 30 miles, however. The seas from the southwest are the most dreaded.

Burlington Bay is exposed to the south, southeast, and east waves, from the last-named direction having a sweep of about 40 miles.

The length of Lake Superior from northeast to southwest is about 320 miles, so that northeast storms are the most dreaded at the head of the lake. The Apostle Islands, off the southerly shore of the lake and about 50 miles eastwardly from Duluth, serve to break the force of easterly storms experienced at Agate and Burlington bays.

Within the last eighteen months the Duluth and Iron Range Railroad has been built from Agate Bay to the Vermillion iron mines, a distance of 65 miles, and an extensive ore dock and a merchandise dock have been built by the railroad and mining companies. During the past season more than 60,000 tons of iron ore were shipped, and it is claimed that 300,000 tons will be shipped next season. Twenty thousand tons of miscellaneous freight are reported as received and shipped in 1884, and 876 arrivals and departure of vessels, large and small, tugs included, are reported for 1884. It is understood that the railroad is to be eventually extended from Agate Bay to Duluth.

Agate Bay particularly needs protection against southwest storms. As it now is, vessels, during such storms, have to change anchorage from this bay to Burlington Bay.

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*Omitted; printed in House Ex. Doc. No. 94, Forty-eighth Congress, second session.

The detailed survey made in December last, resulted in some disappointment. It had been asserted and believed that a close survey would develop locations on the west side of Agate Bay that would admit of the construction of a breakwater of sufficient length to afford protection to the west half of the harbor against southwest storms. To obtain even partial protection by a breakwater on the west side of the bay near the point, as shown by the lines A A or B B, a breakwater would have to be extended out into 40 feet depth of water, a serious and expensive undertaking for a small amount of protection. A breakwater on the line C C, extending into 30 feet of water, would largely protect the ore docks, excepting against the south, but it would be expensive, and even if dredging were done behind it to afford 16 feet depth of water up to the shore, the anchorage area obtained would be small, in addition to which it would probably be too close to the docks and front of the railroad company.

On the easterly side of the bay a breakwater could be constructed at D D with a branch, E E, extending into 28 feet of water, so as to afford anchorage area of about 10 acres protected against the southwest, south, and east, although it would not afford any protection whatever to the ore docks, and the branch E E would probably render it necessary for vessels approaching or leaving the merchandise dock to move in somewhat different courses from those they now take, though that strikes me as a small matter. The bottom of the bay, where the depths exceed 20 feet, is reported as mostly of clay. Bowlders and rock are found on the east side of the bay. The estimated first cost of a breakwater, D D, E E, is placed at $135,000, and of the dredging between it and the shore, which dredging should be regarded as something not to be done until after construction of the breakwater, $25,000.

Turning now to Burlington Bay we find that a breakwater at F F, G G, extending into 28 feet of water, will afford an area of about 15 acres sheltered from the southwest around to the northeast.

This point is much more exposed to the east and northeast storms than is Agate Bay. A submerged reef was found, during the survey, at H H; a breakwater upon this reef, of about 400 feet length, was suggested, but was not further considered on account of the expense and difficulty of maintaining a structure in a position so exposed to the northeast storms and the small additional benefit that could be derived from it. An additional breakwater on the line K K was also suggested to provide a small anchorage area protected against south winds, but it is not at present considered.

The estimated first cost of a breakwater, F F, G G, in Burlington Bay, is placed at $160,000, and that of dredging between breakwater and shore, and which should not be done until after construction of the breakwater, $50,000.

The commerce of Burlington Bay is entirely prospective. The area at M M is part marsh, part clayey bank, so that a basin with slips can be constructed here by private enterprise. Borings made under the auspices of the railroad company showed clay and other material capable of being dredged to depths of 18 feet below the low-water plane of the lake. It is understood that development of this particular locality was contemplated by the railroad and other interests and that they still keep in view its development. A breakwater at present, however, would only be of value as forming a harbor of refuge, there being no harbor of that character on the north shore of Lake Superior within the United States possessions, the partly finished harbor of Grand Marais excepted.

ESTIMATES.

For Agate Bay:	
1,200 linear feet of breakwater	$135,000
Dredging	25,000
	160,000
For Burlington Bay:	
1,100 linear feet of breakwater	160,000
Dredging	50,000
	210,000
Aggregate for the two bays	370,000

In addition to statistics of present and prospective commerce of the bays, as already given, reference is made to those appended to the report herewith of Mr. Randell Hunt, assistant engineer, to whom and to Assistant H. N. Elmer I am indebted for valuable services in making the survey.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. RANDELL HUNT, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., December 31, 1884.

SIR: I have the honor to submit the following report on the survey and examination of Agate and Burlington bays:

In accordance with your instructions, I left Saint Paul for Agate Bay December 5, arriving at the latter place on the 7th.

My party commenced work immediately, making a stadia survey of the coast line and taking soundings. Work was uninterrupted, though most of the time the cold was severe. On the 17th instant I had completed the field work and departed for Saint Paul.

Borings were made in three different places, as shown on the map.

Boring No. 1 was in the bed of a small creek, and was carried to a depth of 17 feet below the lake level, showing a tough yellow clay throughout.

No. 2 was carried to a depth of 17 feet from the surface of the ground, or just to the lake level, when, the drill becoming worn out, it was stopped. The character of this boring was the same as No. 1, excepting a large number of bowlders, mostly of small size.

Boring No. 3 was started in three different spots within a radius of 15 feet, and bowlders were encountered in each place within 6 feet of the surface, and my drill not being suitable to get through them, further boring was abandoned. The Duluth and Iron Range Railroad, under the direction of Mr. R. H. Lee, the chief engineer, had previously made borings to a depth of 18 feet below the lake level at the sites of the ore and merchandise docks in Agate Bay, and in the low area on the west side of Burlington Bay. The character of all was the same, a yellow clay interspersed with occasional bowlders.

Agate Bay is the harbor through which all commerce for the newly developing country situated to the north of it finds entrance and exit. The completion of the Duluth and Iron Range Railroad to the Vermillion iron mines, a distance of 65 miles, and the construction of docks in the bay will tend to increase the amount of commerce rapidly. I append a statement of the shipping improvements and commercial statistics as kindly furnished me by Mr. A. H. Viele, auditor of the Duluth and Iron Range Railroad.

Agate Bay is remarkably deep. The bottom, excepting off and close to the rocky points, consists of yellow clay, with a number of bowlders.

It is almost completely exposed to storms from the southwest, south, and southeast, and to a small extent from the northeast.

Mr. E. B. Brace, of the United States signal office at Duluth, has furnished me with a table showing the prevailing winds at that point for several years back. These results may be applied to the locality of Agate and Burlington bays without any danger of being much out of the way, probably making a small allowance for the increased velocity of those winds which come from the southern quarters, due to the stretch of lake

From this table it appears at a glance that the southwest and northeast storms are the prevailing ones. In addition to this Mr. Brace has informed me by letter—

"That we consider a dangerous wind from any direction to be one of 25 miles or over. I have carefully examined my records from 1875 to date, and cannot find a single instance where a southeast wind has reached that velocity. We occasionally have southeast winds, but it is not a quarter from which we expect storms."

Lake captains and others interested are all agreed that Agate Bay needs most protection from southwest winds; that southeast storms are rare, and that the waves of a continuous northeast storm cause more or less "dead swell" throughout the bay.

It is my opinion that the only practical method, within a reasonable financial limit, for making Agate Bay a place of shelter for vessels is in the construction of breakwaters extending eastward and westward from either side, and *within* a distance of about 400 feet to the north of each outer point.

The breakwater on the west side will have to extend out to the 40-foot contour; that on the east side may stop in 25 feet depth. With these breakwaters, *partial* protection will be afforded from all but due-south storms, and vessels will have to change anchorage from one side to the other of the harbor, according as the storm may be from the southwest or southeast. In addition to these breakwaters, a limited amount of dredging should also be done in the northeast and northwest corners of the bay.

I believe any plan which contemplates the construction of breakwaters further inside the bay, with a view of affording shelter behind them, will so contract the protected area as not to be worthy of serious consideration, when the large coast is taken into account.

A breakwater in 40 feet of water is a serious undertaking, but I do not believe it will be of much material advantage to Agate Bay to construct the one on the west side any shorter, and even this will hardly make the sheltered area from the southwest storms extend beyond the end of the existing ore docks.

Burlington Bay is almost wholly sheltered from southwest storms by the rocky point which separates it from Agate Bay. It is thoroughly opened and exposed to southeast storms and to considerable extent to those from the northeast.

The depth of water is sufficient for vessels throughout the bay up to an average distance of 400 feet from the shore. A submerged rocky reef extends out in a southerly direction some 500 feet from the eastern point of the bay. Excepting this the bottom consists of clay, with more or less bowlders in different places.

This bay might be improved in several ways, probably as effective a method being the construction of a breakwater on top of the rock-reef above referred to, and one out from the rocky point on the west side of the bay, in an easterly direction, for about 600 feet. Behind this breakwater, and up to about 100 feet from the shore, dredging should be done.

Complete shelter can be had in Burlington Bay under these conditions, and, if necessary, and commerce demands, an extension of the works can be made, greatly enlarging the sheltered area, either by lengthening the breakwaters or by carrying the dredged portion over into the swampy piece of ground shown on the west side of the bay, or by doing both.

No commerce seeks Burlington Bay at present, though it is used as a harbor of refuge to some extent by north-shore coasters.

Agate Bay is used for refuge from northeast storms occasionally.

If either or both bays are rendered safer, they would be more generally sought for this purpose.

In concluding this report I wish to bring to your attention the efficient aid rendered me in my survey of the bays by Mr. H. N. Elmer, and to the courtesies shown by the Duluth and Iron Range Railroad.

Very respectfully, your obedient servant,

RANDELL HUNT.

Maj. CHARLES J. ALLEN.

STATISTICS OF BUSINESS DONE AND SHIPPING IMPROVEMENTS AT TWO HARBORS, AGATE BAY, MINNESOTA, SEASON OF 1884, MAY 1, TO DECEMBER, 23.

[Furnished R. Hunt, esq., assistant engineer.]

Ore docks in process of construction and expected to be completed May 1, 1885:		
Cost		$275,000–300,000
Storage capacity	gross tons	10,000
Shipping capacity per season of six months	do	1,000,000 1,200,000
Merchandise docks	cost	$50,000

Ore shipped in 1884, August 18 to October 28 .... tons..	62,100
Ore to be shipped in 1885, May 15 to November 15 .... do....	300,000
Miscellaneous freight received at and shipped from Two Harbors in 1884 .... tons..	20,000
Vessels arriving at and departing from Two Harbors during season of 1884 .... number..	876
Tonnage of same, mainly estimated .... tons..	365,000
Merchandise and miscellaneous freight, other than ore, received and shipped .... estimated value..	$300,000

The port has been largely used during the season of 1884 by vessels in north-shore trade, and promises to be still more useful as a refuge in the future.

A. H. VIELE,
Auditor.

The following is a copy of the prevailing wind directions as taken from the official records at the United States signal station, Duluth, Minn.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1873	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NW.	SW.	SW.	SW.
1874	SW.	SW.	NW.	NE.	NE.	NE.	NE.	NE.	SW.	NE.	SW.	SW.
1875	SW.	SW.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	SW.	NW.
1876	SW.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	SW.	SW.	NW.
1877	W.	SW.	NE.	NE.	NE.	NE.	NE.	NE.	E.	SE.	NW.	NE.
1878	SW.	NE.	NE.	NE.	NE.	NE.	NE.	NW.	NE.	W.	SW.	SW.
1879	SW.	NW.	SW.	NE.	NE.	NE.	NE.	NE.	NW.	NE.	NW.	SW.
1880	SW.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	SW.	NW.	SW.	SW.
1881	SW.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	SW.	SW.
1882	SW.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	NE.	W.	W.
1883	W.	W.	NW.	NE.	NE.	NE.	NE.	NE.	W.	NE.	W. SW.	SW.
Average for 11 years....	SW.	NE.	NE.	NE.	N .	NE.	NE.	NE.	NE.	NE.	SW.	SW.

Very respectfully,

E. B. BRACE,
Observer, Duluth, Minn.

G G 6.

PRELIMINARY EXAMINATION OF SAINT LOUIS BAY AND SAINT LOUIS RIVER, FROM CONNOR'S POINT, WISCONSIN, AND RICE'S POINT, MINNESOTA, TO FOOT OF FIRST FALLS.

ENGINEER OFFICE UNITED STATES ARMY,
Saint Paul, Minn., August 28, 1884.

GENERAL: Referring to my project of the 4th instant, regarding a preliminary examination of Saint Louis Bay and River, "from Connor's Point, Wisconsin, and Rice's Point, Minnesota, to foot of first falls," as provided for in section 9 of the river and harbor act of Congress approved July 5, 1884, I would respectfully state that during a recent journey to Grand Marais, Minn., I was detained in all two days at Duluth, waiting for boat, &c., during which time I was enabled to gather information about the Saint Louis Bay and River, covering as much ground as I expected to cover by the preliminary examination estimated for in my letter of the 4th.

In order to gain time, I beg leave to submit the following as a report of prelimary examination:

Saint Louis Bay is an enlargement of the Saint Louis River above Rice's and Connor's points, discharging between those points into the Bay of Superior. The first named bay, Saint Louis, is about 1½ miles in width by 3 in length, with depths of water varying from 6 feet to 15 feet. The channel between Rice's and Connor's points has depths of 14 to 22 feet. From the head of Saint Louis Bay to Fond du Lac, near the first falls, a distance of about 13 miles, the river is tortuous, with shoals, as well as narrow and deep channels.

The Saint Paul and Duluth Railroad crosses the Saint Louis River at a point about 20 miles from the city of Duluth, and over this track trains of the Northern Pacific Railroad Company, as well as trains of the Saint Paul and Duluth, pass. A branch of the Northern Pacific also enters Superior City.

Portions of the cities of Duluth and Superior front on Saint Louis Bay, as does the town of Oneota.

On the Superior, Wis., side of the bay extensive improvements are in progress and projected. The city of Duluth is extending its wharf lines up the bay. At Fond du Lac are valuable stone quarries, while above it are extensive works for the driving of saw-logs, an industry yearly increasing in value.

Within a short time vessels of the heaviest tonnage will undoubtedly seek access to Saint Louis Bay, if not to points farther up the river, and the whole section, from Rice's and Connor's points to Fond du Lac, will soon become the seat of important commercial enterprises.

The accompanying extract copy of a letter, dated July 19, 1884, from Mr. A. Manvel, general manager of the Saint Paul, Minneapolis and Manitoba Railway Company, affords an idea of the extent of the proposed railroad improvements on the Wisconsin side of Saint Louis Bay.

The railroad companies that are expected to have their terminal grounds at this point are, as stated by the Superior Inter-Ocean (newspaper) July 3, 1884, as follows:

Northern Pacific; Saint Paul and Duluth; Chicago, Saint Paul, Minneapolis and Omaha; Saint Paul, Minneapolis and Manitoba; and the Chicago, Milwaukee and Saint Paul.

It appears, then, that the Saint Louis Bay and River are worthy of improvement, though to what extent and at what cost can only be determined after a thorough survey shall have been made. It would be best to commence such survey at Rice's and Connor's points, carrying it up towards the foot of the falls.

No complete survey of this locality has been made since that of 1861. The lake survey and a new map, showing the extensive artificial changes and the more than probable natural ones of the past twenty-three years, have long been needed.

The estimated cost of a full survey and map is placed at $5,000.

I inclose an outline tracing,* made from the lake survey map of 1861 to show the relative positions of Duluth, Superior, and the Saint Louis Bay and River.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

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*Omitted.

LETTER FROM MR. H. MANVEL, GENERAL MANAGER OF THE SAINT PAUL, MINNEAPOLIS AND MANITOBA RAILWAY COMPANY.

SAINT PAUL, MINNEAPOLIS AND MANITOBA RAILWAY COMPANY,
GENERAL MANAGER'S OFFICE,
Saint Paul, July 19, 1884.

DEAR SIR: A reply to your communication of the 7th instant has been delayed by my absence in Chicago.

I saw General Hammond, however, and presume he may have communicated to you what our intentions are in regard to Superior.

In case he has not, however, I beg to state that the elevated level land from the base of Connor's Point west, say 1¼ miles from the shore of Superior Bay, at the eastern line of section 14, has been selected, on account of its location and topography, for the terminal ground of all the railways now doing business at the head of Lake Superior.

Connor's Point, the projection from this area, bounded on the west by the inlet, may easily and cheaply be made available for use as a harbor. The deep channel between Connor's and Rice's points should be connected along the dock line, with the other deep channel east of Grassy Point, * * * as large coal and elevator interests are now waiting the opening of this channel.

I would say, if the appropriation of 1884 is not available for any portion of the harbor west of Connor's Point, then the channel from the natural entry between Wisconsin and Minnesota points should be straightened, widened, and made as direct as possible to the southeast quarter of the northeast quarter of Section 14, of Superior Bay; thence along the present channel to the northerly end of Connor's Point. Deep water in the channel, as above indicated, with present facilities, can be made to accommodate the large business of the coming year.

I may say in this connection that our own railway finds it impracticable to get the necessary room to handle its business economically on the Minnesota side, and the transaction of our business at the location above referred to will be arranged for as soon as practicable, or as soon as the bridge connecting these facilities with Duluth is in position.

Yours, truly,

H. MANVEL,
General Manager.

Maj. CHAS. J. ALLEN,
Engineer's Office, U. S. A.

SURVEY OF SAINT LOUIS BAY AND SAINT LOUIS RIVER, FROM CONNOR'S POINT, WISCONSIN, AND RICE'S POINT, MINNESOTA, TO FOOT OF FIRST FALLS.

ENGINEER OFFICE, UNITED STATES ARMY,
Saint Paul, Minn., January 22, 1885.

GENERAL: I have the honor to submit the following report of a survey in detail of Saint Louis Bay and Saint Louis River from Connor's Point, Wisconsin, and Rice's Point, Minnesota, to the foot of the first falls, made in accordance with the requirements of section 9 of the river and harbor act of Congress approved July 5, 1884.

The survey commenced December 5, and the field work was completed January 10. Time has not admitted of the completion of all the maps, but the tracing* herewith covers all the ground over which improvements in the interest of navigation will probably be required for a number of years to come.

From Connor's and Rice's points to the first falls the distance measured along the channel approximates 17 miles. The Saint Louis River and Bay, the latter an enlargement in width of the river, form, for the distance surveyed, the boundary between the States of Minnesota and Wisconsin, and discharge into the bay of Superior, through the channel between Rice's and Connor's points. Saint Louis Bay is about 3 miles in length by 1½ miles in width. On the Minnesota side of the bay are the town of Oneota and a portion of the city of Duluth; on the Wisconsin side is the newly laid out town of West Superior. On Connor's Point are large saw-mills, and on the same point, but fronting the bay of Superior, is the dock of the Saint Paul and Pacific Coal Company. The Northern Pacific Railroad Company is now building a bridge across Saint Louis Bay, from Rice's Point to a point on the Wisconsin shore, about 3,000 feet above Connor's Point, this bridge to have two draw openings of 100 feet in the clear, each, over the main channel on the Minnesota side, and, whenever necessary, to be provided with equal draw capacity on the Wisconsin side. Extensive dock-lines, slips, and other private improvements are provided for on the Wisconsin front, as may be seen by the map. None of the docks are built as yet. Several railroads are to have their terminal grounds here, and it is understood that at least one large elevator is to be built on this front and a few hundred feet above the Northern Pacific Railroad Bridge crossing.

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* Omitted.

The business on the Minnesota side of Saint Louis Bay is at present almost entirely confined to the manufacture of lumber, which is shipped by rail, but the rapidly increasing shipping business of the city of Duluth will probably soon reach the bay. The report of the Board of Engineers, January 29, 1881, upon the harbors of Duluth and Superior, contained, among other items, the following:

> Amount * * * required for a channel up the west side of Rice's Point, from the channel of Saint Louis River * * * to the north shore, * * * $38,556.

No excavation has as yet been undertaken on this line. When the necessity arises for improvement here, the estimate of 1881 will probably have to be largely increased.

Inspection of the tracing shows a 16-foot channel extending northwesterly from the south end of Rice's Point for a distance of about 2,000 feet, when it shoals gradually to 12 feet depth, carrying this depth for about 1,000 feet. From the extremity of the 12-foot curve to a point about 2 miles up the bay the depth is quite uniform, averaging 7½ feet. From this point the 16-foot curve again commences, the channel running nearly south, with increasing depth, rounding Grassy Point, and finally merging with the channel of the river near "The Island."

On the Wisconsin side of the bay, along the line marked as the established dock front from Connor's Point and past the Northern Pacific Railroad Bridge crossing, the depth averages 8½ feet.

In order to project any plan of improvement for Saint Louis Bay and River it is necessary to take into consideration the present and prospective commerce to be subserved by the improvement. The commerce to be benefited is almost entirely prospective, but there seems, from statements made by responsible parties, and from the expenditures already made on the Wisconsin side of the bay, no reason to doubt that channels along the West Superior front will be needed in order to provide for large shipments of grain, &c., during the season of 1885.

The statements relied upon are made by officials of the following-named companies: The Wisconsin Land and River Improvement Company, the Lake Superior Terminal and Transfer Railway Company, the Saint Paul, Minneapolis and Manitoba Railway Company.

The improvement for Saint Louis Bay that would seem to be immediately needed, then, is the excavation of a channel on the Wisconsin side past Connor's Point to a point about 1,000 feet above the crossing of the railroad bridge and the excavation of, or rounding off, the triangular-shaped shoal below the bridge, so as to facilitate crossing from the Wisconsin to the Minnesota side, as indicated by the red broken lines on the accompanying tracing; the channel past the dock-line to average in width 250 feet; the excavation to provide for vessels drawing 16 feet of water.

The quantity of excavation or dredging required is placed at

430,000 cubic yards, which, at an estimated cost of 15 cents per cubic yard, makes the cost	$64,500
Add for contingencies 10 per cent	6,450
	70,950

The extent and cost of further improvements in the bay can be estimated, when needed, by means of the complete maps of the survey just made.

It should be noted that the bed of the bay is like that of the bay of Superior, composed of easily-moved material, so that dredged channels will undoubtedly require retouching from time to time in order to maintain full depth.

In case of appropriations being made for improvements in Saint Louis Bay the amounts to be expended on each side thereof might, it is suggested, be fixed by legislation instead of being left to be apportioned by the Engineer Department.

As bearing upon prospective commerce, I inclose herewith a copy of letter from Mr. J. H. Hammond, manager Land Improvement Company, and vice-president and manager Terminal Company, dated October 2, 1884.

I also inclose a copy of the report, dated January 19, of Assistant Engineer J. B. Parkinson, who made the survey under my direction. To him and to his assistants, D. W. Kinnaird and W. B. Silvey, as well as to the other members of the surveying party, I am indebted for the successful accomplishment of the survey, made during severely cold weather.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. JOHN B. PARKINSON, ASSISTANT ENGINEER.

ONEOTA, MINN., *January* 19, 1885.

SIR: I have the honor to present the following progress report on the survey of Saint Louis Bay and River, together with a tracing (Sheet No. 1), embracing the bay proper and a portion of the river as far up as "The Island." Sheet No. 2, now in course of preparation, will embrace the remainder of the river up to Fond du Lac.

* * * * * * *

An examination of the tracing forwarded discloses the following facts:

A channel, indicated by the 16-foot curve, extends northwest along Rice's Point from its end, a distance of about 2,000 feet.

Here the channel ends, and from this point up the bay the bottom is exceedingly uniform, averaging between 7 and 8 feet depth. A little more than 2 miles from the end of the Rice's Point Channel the 16-foot curve is again encountered, its end being distant about 3,000 feet northeast of Grassy Point. From this point the channel runs nearly south, with increasing depth, rounds the lower end of Grassy Point, then extends in a northwest direction nearly parallel to its west shore, and then, bending gradually to the west and south, merges into the channel of the river near "The Island."

In considering the bay with a view to future improvement I have neglected entirely, for the present at least, any consideration of a project for connecting the channel at Rice's Point with the channel near Grassy Point, as the great length of channel required would entail an expenditure far beyond any apparent needs of commerce at the present time.

I would present the following recommendations for consideration as to the improvement of the lower end of the bay:

1. The creation of a harbor area in the triangular area bounded by the Northern Pacific Railroad Bridge, the present natural channel, and the dock lines of Connor's Point and West Superior. This would require about 800,000 cubic yards of dredging to bring it to a depth of 18 feet. Such an area will in my opinion eventually be needed by all interests, if the business along Rice's Point and at West Superior increases as it is expected to do. For the present it would seem that a channel 250 feet in width and extending parallel to the dock lines from the natural channel near the end of Connor's Point to a point about 1,800 feet west of the Northern Pacific Railroad Bridge would serve all present demands of commerce. Such a channel would have a length of about 4,100 feet and would require about 360,000 cubic yards of dredging to bring it to a depth of 18 feet.

2. The extension of the natural channel from its present terminus parallel to the dock line on the west side of Rice's Point. Such a channel, 250 feet in width and 2,000 feet in length, would require about 160,000 cubic yards of dredging to obtain a depth of 18 feet. A channel of the above dimensions would, in my opinion, serve all interests in that vicinity for the next year or more. Its future extension could be guided by the apparent necessities arising with the growth of commerce.

In this connection I may state that I am unable to learn whether there is any demand as yet for the improvement of the bay along Rice's Point; that is, a demand based upon actual or proposed improvements. No docks worthy of the name exist in this vicinity, and the only business along the shore is that of the saw-mills, of which there are several in this locality. These mills obtain their logs in rafts towed by tugs drawing 7 or 8 feet of water, and ship the manufactured product entirely by rail.

What changes the completion of the Northern Pacific Railroad Bridge may work along Rice's Point it is impossible now to predict, but there is no very apparent and pressing necessity for improvement there at present.

On the Wisconsin shore a new town, named West Superior, has been laid out, and considerable money expended in clearing, grading, and ditching the streets.

The Chicago, Saint Paul, Minneapolis and Omaha Railroad have built their line into the town, and about thirty or forty buildings have been erected.

As yet no improvements have been begun along the shores of the bay in this locality, so that I am unable to know with certainty just what will be required here.

It is claimed that several other railroads, coal companies, &c., will erect docks along the water-front in the near future. As yet, however, nothing has been done.

Although unable to gauge with any accuracy the magnitude of the future commerce of West Superior, I give it as my judgment that in view of the money already expended, and from the start the place has taken since last fall, enough business will probably arise to justify the improvement recommended above.

As above stated, the only manufacturers on Saint Louis Bay are the lumber mills, whose cut for 1884 is given below:

	Feet, B. M.
Lumber	74,500,000
Shingles	17,700,000
Lath	15,000,000

Three mills, representing an annual cut of about 30,000,000 feet, B. M., were destroyed by fire during the year, and have not been rebuilt.

The above estimate includes Peyton's mill, which fronts on both Saint Louis and Superior bays.

Very respectfully, your obedient servant,

JOHN B. PARKINSON,
Assistant Engineer.

Maj. CHARLES J. ALLEN,
Corps of Engineers, U. S. A.

LETTER OF MANAGER LAND IMPROVEMENT COMPANY AND VICE-PRESIDENT AND MANAGER TERMINAL COMPANY.

SUPERIOR, WIS., *October* 2, 1884.

SIR: The improvements in course of construction and arranged for on the south shore of and adjoining Saint Louis Bay, west of Connor's Point, are as follows:

1st. The Chicago, Saint Paul, Minneapolis and Omaha Railway Company. This track is completed to Saint Louis River Bridge line. In addition to accommodations afforded by the Lake Superior Terminal and Transfer Railway Company, their special grounds will occupy 25 acres. They are making improvements costing about $125,000. This gives direct communication from Superior to Chicago without going to Saint Paul.

2d. Slips, piers, coal docks, and railway tracks by the Youghiogheny Coal Company, to cover 32.27 acres, affording storage for 500,000 tons of coal. The outlay on these improvements is estimated at $256,000, and will probably exceed that sum. Additions will follow as required.

3d. Slips, docks, elevators, and tracks of the Saint Paul, Minneapolis and Manitoba Railway Company for receiving grain by rail and shipping by water. Also by the same railroad company terminal improvements and facilities for handling business at the eastern terminus of their road on Lake Superior. The company has 69 acres, 29 acres in its elevator property and 40 acres in freight yards. The improvements on these two properties are estimated to cost $400,000 for what is now planned. In the letter embodying the above statement as to expenditures, the general manager calls my attention to the fact that the tonnage from the head of Lake Superior over the Saint Paul, Minneapolis and Manitoba Railway to points on that line was three and one-half times as much in 1883 as in the year previous, and the tonnage over the same railway from interior points to Lake Superior was five and one half times as great in 1884 as in 1883. Already during twenty-three days of September the same railway has carried to the head of Lake Superior 2,410 car-loads of wheat.

This vast business neither has nor can obtain suitable accommodations nor space on which to make them at Duluth; it is increasing and compels construction of needed tracks, yards, buildings, docks, and other facilities, where land can be obtained, and where improvements can be made at reasonable expense; also where natural level grades can be had.

4th. The Saint Paul and Duluth Railroad has purchased 18.80 acres adjacent to the Saint Paul, Minneapolis and Manitoba Railway depot grounds, which will be improved and made use of as soon as the Saint Louis River Bridge is completed.

This has been contracted for, to be finished and will be in use by February 1, 1885. The improvements by this company will be worth $75,000, made as rapidly as needed, and will include freight houses, sidings, storing tracks, and other conveniences.

5th. The Northern Pacific Railroad Company has taken 80 acres of land for freight depots, sidings, storing grounds, and other conveniences. Improvements on this land will be commenced on completion of the bridge over Saint Louis River, being constructed by that company. Such improvements will cost upward of $100,000, to be added to as needed.

6th. Another railway company, at present not named, has purchased 41 acres of land for freight yards, docks, shops, engine-houses, and other conveniences. This land will be developed the coming spring; docks, piers, and slips put in as soon as the channel in Saint Louis Bay is opened between Connor's Point and deep water east of Grassy Point. The outlay will exceed $200,000.

7th. The Lake Superior Terminal and Transfer Railway Company. This company is composed of representatives appointed by all the railroad companies at present constructing roads or having access to the head of Lake Superior, and is organized so as to embrace all the railroad companies which may hereafter reach the head of the lake. It will provide tracks and transfer between all the freight houses and yards of different roads, and will connect with all factories, docks, foundries, and business requiring tracks, sidings, and railroad accommodations. This company will have 20 acres in its union depot grounds, and will fully improve the same with passenger depot, tracks, covered ways, and other buildings and conveniences for seven railroad companies; the immediate outlay on which will be $25,000, and additions as needed.

In addition to the passenger depot grounds the company will have at present 120 acres for car transfer yards, and will add to this area as soon as practicable. The total cost of improvements cannot now be stated, as the operations of the company will be progressive.

8th. A strong company is about commencing a large brick hotel, to contain one hundred and twenty-four sleeping rooms, besides offices and usual accommodations; also four stores. The outlay on this building is estimated at $73,000. The foundation will be put in during October, and the building completed as early as possible in 1885.

9th. A dock is now being built on the south shore of Saint Louis Bay, on Section No. 10, for landing material required in the foregoing constructions and in private dwellings and stories now being built. Another dock, with extension of a 100-foot avenue thereto, will be constructed as soon as possible for ferry landing, passengers, and freight, at a cost of about $9,000. Present clearing, draining, and grading of streets, and constructing 2¼ miles of sidewalks this summer and fall, involves an outlay of about $25,000. Brick offices for our own use are now under construction, to cost $2,200.

We opened sale of lots on Friday, September 26. There are at this date (October 2) twelve buildings under contract and nine in course of construction. All are two stories high and not less than 25 by 40 feet each.

If the channel were opened along the dock line on the Wisconsin shore of Saint Louis Bay, the cost of material would be lessened from 10 per cent. to 20 per cent. At present vessels of heavy draught cannot come far enough inside of Connor's Point to be of much assistance, making a long haul by land. The railroad, coal, and ore dock companies will go ahead at once, but a large part of their improvement is now and will be delayed by want of the Government channel in Saint Louis Bay. Work on this at an early day involves interests so great and outlay so large, compared to the small sum with which the Government can promote the foregoing and many other contemplated large enterprises and expenditures, that your early and earnest attention is requested.

The proprietors of two flour mills are awaiting your report before commencing work. If dredging of a channel from Connor's Point west to Saint Louis River Bridge can be looked for the coming year, foundations for these two mills will be laid this fall and winter. They will have capacity of 400 and 500 barrels per day, respectively. I am not informed of the estimated cost.

Respectfully, your obedient servant,

J. H. HAMMOND,
Manager Land Improvement Company,
and Vice-President and Manager Terminal Company.

Maj. CHARLES J. ALLEN,
U. S. Engineer, in charge Lake Superior Harbor Improvements.

APPENDIX H H.

HARBORS ON LAKE SUPERIOR (EAST OF SUPERIOR CITY), ON GREEN BAY, AND ON THE WESTERN SHORE OF LAKE MICHIGAN, NORTH OF MILWAUKEE, WISCONSIN.

REPORT OF LIEUTENANT-COLONEL J. W. BARLOW, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885. *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Ontonagon Harbor, Michigan.
2. Eagle Harbor, Michigan.
3. Marquette Harbor, Michigan.
4. Harbor of refuge at Grand Marais, Michigan.
5. Manistique Harbor, Michigan.
6. Harbor at mouth of Cedar River, Michigan.
7. Menomonee Harbor, Michigan and Wisconsin.
8. Oconto Harbor, Wisconsin.
9. Pensaukee Harbor, Wisconsin.
10. Green Bay Harbor, Wisconsin.
11. Harbor of refuge at entrance of Sturgeon Bay Canal, Wisconsin.
12. Ahnepee Harbor, Wisconsin.
13. Kewaunee Harbor, Wisconsin.
14. Two Rivers Harbor, Wisconsin.
15. Manitowoc Harbor, Wisconsin.
16. Sheboygan Harbor, Wisconsin.
17. Port Washington Harbor, Wisconsin.

EXAMINATIONS AND SURVEYS.

18. Lac la Belle Harbor, Michigan.
19. Ashland Harbor, Lake Superior, Wisconsin.

ENGINEER OFFICE U. S. ARMY,
Milwaukee, Wis., July 29, 1885.

GENERAL: I have the honor to transmit herewith the annual reports upon the river and harbor improvements in my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

J. W. BARLOW,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. Army.

H H 1.

IMPROVEMENT OF ONTONAGON HARBOR MICHIGAN.

Original estimates (see Report of Chief of Engineers, 1867, page 65)	363,770
Appropriated	272,600

The first appropriation for the improvement of this harbor was made in 1867, the project contemplating the construction of two parallel crib piers, 250 feet apart, extending from the mouth of Ontonagon River, in a northwesterly direction, to the 18-foot curve in Lake Superior, and dredging between the piers to a depth of 12 feet at low water, making a channel connecting the deep water in the lake with the deep water in the river.

At the beginning of the fiscal year under consideration the east pier was 2,265 feet long, and the west pier was 2,275 feet long; the channel, for a width of 100 feet, had the contemplated depth of 12 feet, except over a bar near the outer entrance, where the depth was but 11½ feet.

Under the appropriation of $15,000 made July 5, 1884, a contract was entered into with John H. Gillett, on the 17th of September, 1884, for extending the west pier 100 feet, and building 950 linear feet of superstructure over cribs previously sunk; this contract was completed in December of the same year, making the west pier 2,375 feet long.

An examination of this harbor made in June, 1885, and now only partially plotted, shows that to continue the piers to the 18-foot curve will require an addition of about 600 feet to the east pier and 700 feet to the west pier. On the lines of extension of the piers the depths of water are 12 to 13 feet, increasing gradually to 14 feet and quite rapidly to 18 feet. The shoal in front of the entrance shows a general extension into the lake, but it keeps a depth of over 12 feet and there is a channel of 12.5 feet, least depth, all the way up between the piers.

The importance of this improvement as a benefit to local shipping is small compared with its importance as affording to general commerce a refuge during storms at a point where most needed. It is on the latter account that the improvement was begun and has been continued, and the growth of the commerce of Lake Superior makes its completion still more important.

The work contemplated during the fiscal year ending June 30, 1887, should an appropriation be made, will consist in further pier extension and possibly some repairs.

Money statement.

July 1, 1884, amount available	$144 19
Amount appropriated by act approved July 5, 1884	15,000 00
	15,144 19
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	12,848 49
July 1, 1885, amount available	2,295 70
Amount (estimated) required for completion of existing project	91,170 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	60,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for pier extension at Ontonagon Harbor, Michigan, opened at engineer office, Milwaukee, Wis., at 10 o'clock a. m., Tuesday, August 26, 1884.

No.	Names and addresses of bidders.	Price per linear foot of pine timber, 12 by 18 and 12 by 12 inches, framed, 17,500 linear feet.	Price per linear foot of hemlock timber, 12 by 18 and 12 by 12 inches, framed, 3,000 linear feet.	Price per thousand feet of pine plank, 37,000 feet B. M.	Price per cord of stone, 600 cords.	Price per pound of drift bolts, 20,500 pounds.	Price per pound of screw bolts, 1,500 pounds.	Price per pound of spike, 2,100 pounds.	Price per thousand, relaying 15,000 feet, B. M., pine plank.	Total approximate value of bid.
1	John H. Gillett, Marquette, Mich.	$0 32	$0 32	$20 00	$9 00	$0 04	$0 05	$0 04	$8 00	$13,799 00
2	Joel Rich, Juneau, Mich	50	50	20 00	11 00	04½	06	05	20 00	19,007 50
3	Horatio N. Smith, Milwaukee, Wis.	32	32	16 00	9 25	04½	06	04½	5 00	13,884 00

List of materials and labor used at Ontonagon Harbor, Michigan, in the construction of two cribs, each 50 × 20 × 12½ feet, and building, filling, and planking 400 linear feet of superstructure, six courses high, and raising 550 linear feet of superstructure to full height by the addition of two courses of timber.

[Under contract with John H. Gillett, dated September 17, 1884.]

Materials.	Two cribs.	Superstructure east pier filled and planked 300 linear feet, six courses.	Superstructure west pier filled and planked 100 linear feet, two courses.	Superstructure west pier not filled or planked 550 linear feet, two courses.	Price.	Cost.
Pine timber 12 x 12 inches....linear feet..	6,428	7,122	952	4,280	$0 32	$6,010 24
Pine plank relaid ....feet, B. M..	5,238	11,995	....	....	8 00	137 86
Pine plank, new......................do....	....	9,521	....	....	20 00	190 42
Stone ....cords..	240	195.3	30	46.3	9 00	4,604 40
Drift bolts ....pounds..	5,186	6,921	845	3,805	04	670 28
Screw bolts ....do....	1,208	....	....	....	05	60 40
Spike ....do....	230	696	180	35	04	45 64
Total cost	$4,535 90	$4,627 80	$615 64	$1,939 90	....	11,719 24

Cost of one crib	$2,267 95
Cost of one crib per linear foot	45 36
Cost per linear foot of superstructure six courses high, filled and planked.	15 43
Cost per linear foot of superstructure two courses high, filled and planked.	6 15
Cost per linear foot of superstructure two courses high, not filled or planked.	3 53

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from James Mercer.]

Name of harbor, Ontonagon, Mich.
Collection district, Superior, Mich.
Nearest light-house, Ontonagon, Mich.

Arrivals and departures of vessels.

Class.	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers	135	84,700	3,175	135	84,700	3,175
Sailing vessels..................	37	18,500	296	37	18,500	296
Total	172	103,200	3,471	172	103,200	3,471

EXPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Copper ... tons	600	Laths ... number	3,500,000
Fish ... do	31	Lumber ... feet B. M	18,500,000
Hides ... do	9	Merchandise, general ... tons	210

IMPORTS BY WATER.

Apples ... barrels	720	Oats ... bushels	35,500
Brick ... number	290,000	Pork ... barrels	260
Coal ... tons	870	Powder ... tons	10
Corn ... bushels	3,227	Salt ... barrels	400
Flour ... barrels	3,530	Shingles ... number	596,000
Lime ... do	685	Stone ... cords	112
Live stock ... number	256	Sugar ... barrels	535
Lumber ... feet B. M	176,000	Whiskey ... do	137
Merchandise, general ... tons	1,300		

H H 2.

IMPROVEMENT OF EAGLE HARBOR, MICHIGAN.

Modified estimate (see Report of the Chief of Engineers, 1876, II, 328, 1877, I, 98, II, 845)	$97,000
Appropriated	97,000

The project for the improvement of this harbor was completed in 1879.

It consisted in blasting a channel 130 feet wide and 14 feet deep through a rocky ledge, and in placing guiding-cribs on each side of the channel to indicate its position.

Last summer it was ascertained that some bowlders had been washed into the channel, reducing its available depth in places to 12 and 13 feet.

Proposals were solicited by letter from different parties doing business or living in the vicinity, to remove these obstructions. The following proposals were received:

(1) John H. Gillett, Marquette, Mich., $150 per day for use of plant and outfit to be sent from Marquette; the time to be counted from date of leaving Marquette to date of return; $75 per day to be deducted for detentions by weather.

(2) Charles S. Barker, Sault Sainte Marie, Mich., $135 per day for plant and outfit to be sent from Port Arthur, Canada; time to be counted from date of leaving that place until date of return; no deduction for weather.

(3) Williams & Upham, L'Anse, Mich., $2,000.

These prices were considered too high, and an arrangement was made with William P. Raley, of Eagle Harbor, Mich., to clear the channel by hired labor and purchase of appliances in open market.

After the lapse of a month the rate of progress was found to be so slow that as soon as an experienced man could be spared from the works on Lake Michigan he was sent to Eagle Harbor, with diving apparatus.

It was the middle of November before operations were begun. After removing a small part of the obstructions, tempestuous and freezing weather set in, precluding further submarine work.

The work will be completed early in July.

Money statement.

July 1, 1884, amount available	$3,788 93
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	575 09
July 1, 1885, amount available	3,213 84

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from W. P. Raley.]

Name of harbor, Eagle Harbor, Mich.
Collection district, Superior, Mich.
Nearest light-house, Eagle Harbor, Mich.

Arrivals and departures of vessels.

Class.	Arrivals.	Departures.
Steamers	76	76
Sailing vessels	5	5
Total	81	81

EXPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Copper ... tons	1,599	Live stock ... number	6
Fish ... packages	224	Powder ... kegs	84
Hides ... bundles	553	Tallow ... pounds	10,000
Merchandise, general ... pounds	164,150		

IMPORTS BY WATER.

Apples ... barrels	711	Lime ... barrels	302
Beer ... cases	155	Live stock ... number	575
Brick ... number	12,200	Lumber ... feet	119,574
Coal ... tons	3,884	Malt ... pounds	72,280
Corn ... pounds	271,056	Oats ... do	849,295
Feed, &c ... do	576,315	Oil ... barrels	319
Flour ... barrels	2,906	Powder ... kegs	2,197
Groceries, &c ... pounds	1,185,990	Salt ... barrels	176
Hay ... do	257,685	Shingles ... number	35,000
Iron, &c ... do	448,184		

H H 3.

IMPROVEMENT OF MARQUETTE HARBOR, MICHIGAN.

Original estimate (see Report of Chief of Engineers, 1866, III, 8; IV, 81)	$385,129 58
Appropriated	319,230 00

The project for the improvement of this harbor was adopted in 1886. It consisted in the formation of a crib breakwater, extending from a point north of the city of Marquette in a direction due south for a distance of 2,000 feet, thus affording a protection to the water-front of the city.

Work was begun in 1867, and the breakwater was completed to its present length of 2,010 feet in 1875, at a cost of about $291,000 or $94,000 less than the estimated cost. Since its completion, appropriations amounting to $27,000 have been made; of which about $15,000 have been expended on repairs.

In 1877 the officer in charge of the improvement recommended that the breakwater be extended 400 feet beyond its present limit; the increased business of the port since then renders still further protection very desirable.

It is proposed, with the sanction of the Department, to retain the funds now on hand, for this purpose, with the exception of such amounts as may be needed for current repairs, until by future appropriations a sufficient sum becomes available to prosecute new work advantageously.

No work has been done at this harbor during the past fiscal year, except taking and recording water-level observations.

An instrumental examination of the harbor was made in June, 1885, with a view to determine changes which may have occured since the last survey.

Money statement.

July 1, 1884, amount available	$7,167 32
Amount appropriated by act approved July 5, 1884	5,000 00
	12,167 32
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	551 30
July 1, 1885, amount available	11,616 02
Amount that can be profitably expended in the fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	100,000 00

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from the collector of customs.]

Name of harbor, Marquette, Mich.
Collection District, Superior, Mich.
Nearest light-house, Marquette, Mich.

Arrivals and departures of vessels.

Class.	Arrivals.		Departures.	
	No.	Tonnage.	No.	Tonnage.
Steamers	379	364,310	379	364,310
Sailing vessels	322	193,481	321	193,282
Total	701	557,791	700	557,592

Detailed statistics of the commerce of the port of Marquette for 1884 could not be obtained. Those given below are for the previous year.

EXPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Fish .... packages	700	Lumber .... feet B. M.	2,427,000
Hides .... pounds	100,460	Machinery .... pounds	71,820
Household goods .... do	333,530	Merchandise generally .... do	440,150
Iron ore .... tons	774,127	Quarts .... do	2,010,300
Iron, pig .... do	10,145	Stone .... cords	321
Live stock .... number	18	Tallow .... pounds	68,720

IMPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Apples .... barrels..	5, 506	Hay .... tons..	485
Beef .... pounds..	70, 840	Iron and steel .... pounds..	1, 144, 580
Beer .... ½ barrels..	26	Leather .... do....	667
Brick .... number..	610, 000	Live stock .... number..	162
Coal .... tons..	36, 592	Machinery .... pounds..	13, 205
Corn .... bushels..	3, 164	Merchandise generally .... do....	9, 914, 292
Dry-goods .... tons..	2, 106	Oil .... barrels..	6, 118
Feed .... do	162	Pork barrels .... number..	549
Flour .... barrels..	969	Provisions .... pounds..	417, 297
Fruit .... pounds..	13, 341	Salt .... do....	538, 250
Groceries .... do	320, 621	Shingles .... number..	70, 000
Hardware .... tons..	2, 145	Stone .... pounds..	1, 056, 280

H H 4.

HARBOR OF REFUGE AT GRAND MARAIS, MICHIGAN.

Original estimate (see Report of Chief of Engineers, 1881, page 2053)	$450, 000
Appropriated	105, 000

The necessity for a harbor of refuge on the American shore of Lake Superior, at some point between White Fish Bay and Grand Island, a distance of 85 miles, was felt by navigators long before the commerce of the lake had assumed the importance it now possesses.

Grand Marais, from its locality, about midway between these points, and from its natural topographical features, seemed to be the most desirable place for the construction of a work of the character needed.

Surveys of the locality were made in 1871 by Maj. D. C. Houston and in 1881 by Maj. H. M. Robert. The present project of improvement was adopted on the report of a Board of Engineer Officers made in the latter year.

It consists in the construction of an artificial entrance to the natural harbor, by cutting a channel through the sand-spit which protects the harbor on the north, and in building two crib-piers, extending from the cut to the 22-foot curve in Lake Superior, the distance between the piers to be 500 feet.

The first appropriation for this work was made in 1880, $10,000 being granted. This sum was not sufficient to commence work with to advantage, and remained unexpended, until, by the appropriation of $20,000 in 1881 and $40,000 in 1882, enough money was available with which to begin operations.

A contract was entered into in October of the latter year and work of pier construction was begun. At the beginning of the present fiscal year the east pier had a length of 600 feet and the west pier 700 feet.

Under the appropriation of $35,000, made July 5, 1884, a contract was entered into with John H. Gillett, of Marquette, for building 500 linear feet of superstructure over cribs sunk in 1882 and 1883, and extending the east and west piers 150 and 300 feet, respectively. Of the nine cribs required for these extensions, the first two, to be sunk in line of the east pier, will be 20 feet wide and the others 24 feet wide. During the fiscal year ending June 30, 1885, the superstructure called for by the contract was completed, with the exception of 100 linear feet on the west pier, which was built up to the required height of six courses, but not filled or planked. The west pier was extended 50 feet by sinking one crib.

With the money asked for the fiscal year ending June 30, 1887, it is contemplated to extend the piers as rapidly as possible.

Money statement.

July 1, 1884, amount available	$5,004 94
Amount appropriated by act approved July 5, 1884	35,000 00
	40,004 94
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	8,239 61
July 1, 1885, amount available	31,765 33
Amount (estimated) required for completion of existing project	345,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	200,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for pier extension at Grand Marais Harbor, Michigan, opened at engineer office, Milwaukee, Wis., at 10 o'clock a. m., Tuesday, August 26, 1884.

No.	Names and addresses of bidders.	Pine timber, 12 by 18 inches and 12 by 12 inches, framed, per linear foot; 30,000 linear feet.	Hemlock timber, 12 by 18 inches, and 12 by 12 inches, framed, per linear foot, 20,300 linear feet.	Pine plank per M feet, 25,000 feet, B. M.	Stone, per cord, 1,600 cords.	Drift bolts per pound, 44,000 pounds.	Screw bolts per pound, 9,500 pounds.	Spikes, per pound, 2,000 pounds.	Relaying 25,000 feet, B. M., pine plank, per M.	Total approximate value of bid.
		Cts.	Cts.			Cts.	Cts.	s.		
1	John H. Gillett, Marquette, Mich	32	32	$20	$8	4	5	4	$8	$31,911
2	Castle Sutherland, East Saginaw, Mich	30*	No bid.	20	10	5	5	5	4	34,465

* Pine and hemlock 50,300 linear feet.

H H 5.

IMPROVEMENT OF MANISTIQUE HARBOR, MICHIGAN.

Original estimate (see Report of Chief of Engineers, 1880, page 1931)	$6,000
Appropriated	6,000

The project of improvement for this harbor consisted in dredging between piers built by the Chicago Lumbering Company, increasing the depth of the channel to 12 feet for a width of 150 feet.

An appropriation of $5,000 was made for this purpose in 1880, and of $1,000 in 1881.

The only work done under these appropriations was the removal of 11,780 cubic yards of material in 1880, under a contract with the Chicago Lumbering Company.

In October, 1880, a survey of the harbor showed that the direction of the piers lay across the natural channel. At this time the company, which had built the piers and had also secured the contract for dredging, found it necessary to renew about 330 feet of the west pier, which had been washed away.

The superintendent of the company was notified by the officer in charge, Maj. H. M. Robert, that the pier lines would have to be rectified to accord with the natural channel. The company declined to comply with this demand, and their contract, which had been extended from December, 1880, to June 1, 1881, was suspended.

There have been no operations at this harbor since, and no money is asked for its improvement.

Money statement.

July 1, 1884, amount available	$3,501 79
July 1, 1885, amount available	3,501 79

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from William M. Colwell.]

Name of harbor, Manistique, Mich.
Collection district, Superior, Mich.
Nearest light house, Poverty Island.

Arrivals and departures of vessels.

Class.	Arrivals.		Departures.	
	No.	Tonnage.	No.	Tonnage.
Steamers	252	15,750	252	15,750
Sailing vessels	31	11,750	31	11,750
Total	283	27,500	283	27,500

EXPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Lumber feet B. M.	35,000,000	Laths number	5,500,000
Pickets number	125,000	Shingles do	2,000,000
Posts do	500	Slabs cords	1,000

IMPORTS BY WATER.

Apples barrels	300	Groceries pounds	100,000
Beef pounds	50,000	Hardware tons	30
Beef barrels	300	Hay do	500
Beer do	100	Iron and steel do	50
Brick number	65,000	Live stock number	300
Coal tons	50	Machinery pounds	150,000
Corn bushels	4,000	Oats bushels	25,000
Dry goods tons	50	Oil barrels	250
Feed do	10	Pork barrels number	400
Flour barrels	2,000	Salt pounds	10,000

H H 6.

IMPROVEMENT OF MOUTH AND HARBOR OF CEDAR RIVER, MICHIGAN.

Original estimate (see Report of Chief of Engineers, 1882, page 2121)	$138,000
Appropriated	30,000

The project for improving this harbor contemplated the construction of two piers, 200 feet apart, extending from the river-mouth to the 16-foot curve in Green Bay, and the dredging of a channel not less than 12 feet deep at low water; about 800 feet of these piers, beginning at the shore line, to be built of piles, and the remainder of cribs.

The first appropriation ($15,000) for carrying out this project was made in 1882, and was applied to the construction of a pile pier 14 feet wide, extending from the east bank of the river into the bay, a distance of 553 feet.

This is the entire length of pier-work completed. The channel south of this structure has been dredged to a depth of about 14 feet for a width of 120 feet. During the past fiscal year a contract was entered into with Green's Dredging Company, under which 10,583 cubic yards of material were removed from the channel. This contract was finished in November.

Bids for pier extension were also invited by advertisement, to be opened August 26. But one bid had been received at the hour for opening, which was rejected. Under readvertisement, a contract was entered into with Schwarz & Berner, of Green Bay, Wis., for building 500 feet of pile pier.

The work has not yet advanced sufficiently to report an increase in the length of the pier.

At the close of the season operations under this contract should result in extending the east pier 200 feet, making its total length 753 feet, and in the construction of the first 300 feet of the west pier.

Under date of October 14, 1884, a change in the direction of the piers yet to be built was recommended and approved, and the extension will be continued in a direct line with the part already built, instead of at an angle as originally proposed. The advantages to be gained by this change of direction are:

(1) Vessels approaching the channel will avoid a gravel shoal, which would lie directly in their path were the piers extended in accordance with the original plan, or the shoal would have to be removed.

(2) Vessels will be able to lay a course in entering the harbor which will carry them clear of the shoal, and after entering can make a straight course, instead of having to avoid a projecting angle in the pier.

The commerce of Cedar River is entirely local and incidental to a single saw-mill. A harbor of refuge does not seem to be needed at this point, and if it were, the conditions are not favorable for its construction.

Money statement.

July 1, 1884, amount available	$1,119 82
Amount appropriated by act of July 5, 1884	15,000 00
	16,119 82
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,932 74
July 1, 1885, amount available	13,187 08
Amount (estimated) required for completion of existing project	108,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for pier extension at Cedar River Harbor, Michigan, opened at engineer office, Milwaukee, Wis., at 10 *o'clock a. m., Tuesday, August* 26, 1884.

Name and address of bidder.	White oak round piles (if required), per linear foot.	Round piles, other than white oak, per linear foot, 16,250 linear feet.	Norway sheet-piling, per M. feet B. M., 75,000 feet B. M.	White oak timber, per M. feet B. M., 30,750 feet B. M.	Pine timber 12 by 12 inches, per linear foot, 1,000 linear feet.	Pine timber 6 by 12 inches, per linear foot, 1,500 linear feet.	Pine plank, per M. feet B. M., 5,000 feet B. M.	Stone, per cord, 560 cords.	Screw-bolts and tie-rods, per pound, 13,000 pounds.	Spikes, per pound, 600 pounds.	Total approximate value of bid.
Green's Dredging Company, O. B. Green, president, Chicago, Ill	$0 32	$0 21	$32 00	$45 00	$0 30	$0 22	$20 00	$ 25	$0 07	$0 07	$11,818 25

Abstract of bids for pier extension at Cedar River Harbor, Michigan, opened at engineer office, Milwaukee, Wis., at 10 *o'clock a. m., Tuesday, October* 21, 1884.

No.	Names and addresses of bidders.	White-oak round piles (if required), per linear foot.	Round piles other than white oak, per linear foot, 16,250 linear feet.	Norway sheet piling, per M. feet, B. M., 75,000 feet, B. M.	White-oak timber, per M. feet, B. M., 30,750 feet, B. M.	Pine timber, 12 × 12 inches, per linear foot, 1,000 linear feet.	Pine timber, 6 × 12 inches, per linear foot, 1,500 linear feet.	Pine plank, per M feet, B. M., 5,000 feet, B. M.	Stone, per cord, 560 cords.	Screw-bolts and tie-rods, per pound, 13,000 pounds.	Spikes, per pound, 600 pounds.	Total approximate value of bid.
1	Robert H. Canfield and Aaron F. Chapman, Watkins, N. Y	$0 24	$0 20	$35 00	$30 00	$0 27	$0 15	$24 00	$7 00	$0 05	$0 05	$12,012 50
2	Olof A. Norman, Escanaba, Mich	78	29	26 50	40 00	27	22	16 00	6 50	8	10	13,350 00
3	Christian Schwarz and Charles Berner, Green Bay, Wis	25	17	26 00	44 00	24	14	14 00	5 00	5½	5	10,130 50
4	Horatio Truman and George Cooper, Manitowoc, Wis	30	20	26 00	40 00	22	18	15 00	5 10	4¾	3¾	10,491 00
5	Jasper Hanson and Hans M. Scove, Manitowoc, Wis	25	17	32 00	45 00	26	15	15 00	5 50	5	4	10,860 25

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Spalding Lumber Company.]

Name of harbor, Cedar River, Mich.
Collection district, Superior, Mich.
Nearest light-house, Chamber's Island

Arrivals and departures of vessels.

Class.	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers	137	10, 180	1, 088	137	10, 180	1, 088
Sailing vessels	121	35, 856	897	121	35, 856	897
Total	258	46, 036	1, 985	258	46, 036	1, 985

EXPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Bark ... cords	1, 200	Shingles ... number	4, 000, 000
Fish ... packages	4, 300	Slabs ... cords	4, 000
Laths ... number	5,000,000	Poles, telegraph ... number	4, 500
Lumber ... feet, B. M.	24,000,000	Ties, railroad ... do	65, 000
Posts ... number	95, 000		

IMPORTS BY WATER.

Apples ... barrels	300	Hay ... tons	12
Beef ... pounds	55, 000	Iron and steel ... pounds	40, 000
Beer ... barrels	245	Leather ... tons	2
Brick ... number	45, 000	Lime ... barrels	135
Coal ... tons	40	Live-stock ... number	225
Corn ... bushels	550	Machinery ... pounds	120, 000
Dry goods ... tons	30	Merchandise, general ... do	85, 000
Feed ... do	240	Oil ... barrels	150
Flour ... barrels	1, 100	Pork, barrels ... number	200
Fruit ... pounds	6, 000	Provisions ... pounds	22, 000
Groceries ... do	21, 000	Salt ... do	150, 000
Hardware ... tons	12		

H H 7.

IMPROVEMENT OF MENOMONEE HARBOR, MICHIGAN AND WISCONSIN.

Original estimate (see Report of Chief of Engineers, 1874, I, page 139)	$212, 000
Appropriated	200, 000

Approved project.—The continuation of two parallel piers, about 400 feet apart, extending from the mouth of Menomonee River to the 16-foot curve in Green Bay, and dredging a channel between them, not less than 14 feet deep at low water, connecting the deep water in the river with the deep water in Green Bay.

The first appropriation for the improvement of this harbor was made in 1871.

During the past fiscal year, under a contract with Schwarz & Berner, of Green Bay, Wis., superstructure was built, filled and planked, over seven cribs of the north pier, 350 linear feet, and over fourteen cribs of the south pier, 700 feet. The contract was finished in November last.

The north pier, including the pier-head, is now completed in accordance with the existing project, being 1,854 feet long and terminating at the 16-foot curve. The south pier is 2,710 feet long and will have to be extended 350 feet farther to attain the same depth of water.

This will cause it to project 450 feet beyond the present terminus of the north pier.

In my last annual report I stated that "the extension of the piers since then (1881) would naturally tend to prevent this shoaling and it is thought that by extending them to the 18-foot curve in the bay all danger of obstruction from this source would be obviated;" and submitted an estimate of the cost of such extension, which was $88,000 more than the original estimate of $212,000 for extending the piers to the 16-foot curve.

An examination of this harbor was made at the close of the fiscal year, which shows a channel between the piers of 12 feet depth and 150 feet width, with a narrow channel 13 feet deep.

A comparison of the soundings with those in the map of 1881, shows that as the piers are carried out across the bar the depth on the bar increases, so that between the present ends of the piers there is 12 to 14 feet depth where in 1881 there was 9 to 10½ feet. Also the 12-foot curve has pushed out 150 feet farther, forming a narrow spit in prolongation of the south pier. The 18-foot and 24-foot curves show no material changes, and the depth south of the south pier is the same as in 1881.

North of the north pier the 12-foot curve has been carried 600 feet farther out, due to dumping dredged material, mostly private work. In its present condition this is no detriment to the harbor.

The south pier is improperly used as a wharf by the Menomonee River Lumber Company for storing and handling lumber, and the north pier is used as a mooring wharf for heavy lumber barges.

Such use of these piers has caused serious damage, in several instances necessitating repairs, and is a constant source of deterioration, rendering more frequent renewals of the superstructure necessary, and threatening the stability of the whole structure.

In compliance with General Order No. 13, headquarters Chief of Engineers, dated July 23, 1884, issued to meet the requirements of section 2 of the river and harbor act of July 5, 1884, I made a report on this subject last November, from which the following extracts are taken:

> The questions growing out of the private occupation of Government piers at many of the lake ports, which, in some instances, lead to very embarrassing complications, would seem to render immediate legislation upon this subject a matter of great importance. I would, therefore, respectfully suggest that the enactment of a suitable law be recommended, which shall clearly define the jurisdiction of the United States over piers and other works built by Congressional appropriations, and making it a penal offense for any individual or corporation to occupy or use for private or commercial purposes any such structure without having first obtained the written authority of the Secretary of War.
>
> It seems also advisable that such a law should contain a proviso permitting and authorizing the Secretary of War to transfer to the proper city or town authorities the control of any portion of such works, which, having become, by accretions to the shores adjacent, or from other causes, no longer a part of the necessary protection of the harbor entrance, are still essential in maintaining the inner harbor, and are also valuable for wharfage or other commercial purposes, a condition of such transfer being, that the works so transferred shall be kept in perpetual repair by the local authorities.
>
> A report upon the occupation of the Government piers at this harbor was made by my predecessor, Lieut. Col. Henry M. Robert, Corps of Engineers, United States Army, under date of October 12, 1876.
>
> Referring to the inner or slab portion of the north pier this report states:
>
> "This portion of the north pier was cut off from the river channel, and would soon be cut off from the bay also. Under these circumstances it became inclosed by the property of the R. Stevenson and Company's saw-mill and I told the company that I had no objection to their using it as long as their property was in such a shape as to prevent the bay breaking into the river."
>
> This part of the Government pier had been built in 1872, and subsequently became inclosed by improvements made by the saw-mill company. Still later, the space north of this slab pier was reclaimed by filling in with slabs, saw-dust, &c., the work being done by the mill company, thus effectually protecting the lake side of the pier.
>
> I can see no objection to the mill company using and occupying this part of the work.

The crib extension of this pier, however, extending beyond the shore-line, is being constantly injured by the pounding of barges, which are moored alongside while being made up into tows.

A large part of the south pier is used by the Menomonee River Lumber Company for the storage of lumber.

At the date of writing this report a length of 1,800 feet of the inner end of the south pier is almost entirely appropriated by this company. The lumber is piled from 12 to 16 feet high, leaving for a part of the distance a clear space of about 2 feet in width on the channel side of the pier, and projecting beyond the south side for a distance of from 6 to 12 feet over the water.

This storage of lumber is not occasional, but constant.

To prevent further damage to the north pier, the superstructure of which has been greatly weakened by mooring heavy lumber-scows alongside, I last fall had conspicuous notices placed upon it prohibiting this practice. I have recently learned that little if any attention has been paid to these notices, and that this improper use of the pier still continues.

Such wanton disregard of the public interests by those for whom these improvements have been most specially provided seems surprising, and can only be accounted for on the theory that the permanence of their harbor is of secondary importance, their only desire being to make as much use of the piers as possible for their immediate profit. As remonstrances seem to have no effect, and as it is hardly expedient to place guards on the piers to protect them, I think the Government should suspend further work at this harbor unless these injurious encroachments are discontinued.

Money statement.

July 1, 1884, amount available	$921 61
Amount appropriated by act approved July 5, 1884	10,000 00
	10,921 61
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,267 39
July 1, 1885, amount available	3,654 22
Amount (estimated) required for completion of existing project	12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	12,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for pier extension at Menomonee Harbor, Michigan and Wisconsin, opened at engineer office, Milwaukee, Wis., at 10 o'clock a. m., Tuesday, August 26, 1884.

No.	Names and addresses of bidders.	Pine timber, 12 by 12 inches, 14,500 linear feet, per linear foot.	Pine plank, 35,000 feet B. M., per foot B. M.	Stone, 450 cords, per cord.	Drift-bolts, 15,000 pounds, per pound.	Screw-bolts, 200 pounds, per pound.	Spikes, 1,700 pounds, per pound.	Relaying 5,000 feet B. M. pine plank, per foot B. M.	Total approximate value of bid.
1	Hanson & Scove, Manitowoc, Wis	$0 28	$16 00	$5 50	$0 04	$0 05	$0 05	$4 00	$7,810 00
2	Truman & Cooper, Manitowoc, Wis	22	13 00	5 25	03	05	04	2 50	6,548 00
3	Christian Schwarz & Charles Berner, Green Bay, Wis	22	13 00	4 50	03½	04	04	5 00	6,296 00
4	Green's Dredging Company, O. B. Green, president, Chicago, Ill	29½	18 00	5 00	04	07	06	5 00	7,898 50
*5	Aaron F. Chapman, Robert H. Canfield, and Henry A. Canfield, Watkins, N. Y	27	24 00	5 00	05	05	05	10 00	7,900 00

* Received by express at 4.45 o'clock p. m., Tuesday, August 26, 1884.

List of materials and labor used at Menomonee Harbor, Michigan and Wisconsin, in completing, filling, and planking 1,050 *linear feet of superstructure* 20 *feet wide, and* 50 *linear feet* 24 *feet wide, varying in height from one to five courses (average height two and two thirds, courses, or* 32 *inches).*

[Under contract with Schwarz & Berner, dated September 12, 1884.]

Materials.	Quantity.	Price.	Cost.
Timber, 12 by 12 inches ....linear feet..	12,788	$0 22	$2,813 36
Pine plank, relaid ....feet B. M..	5,438	5 00	27 19
Pine plank, new ....do..	54,796	13	712 35
Stone ....cords..	439½	4 50	1,977 75
Drift-bolts ....pounds..	13,428	03½	469 98
Screw-bolts ....do..	254	04	10 16
Spike ....do..	2,250	04	90 00
Total cost	....	....	6,100 79

Cost per linear foot, $5.81.

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Mr. Joseph H. Sommerville.]

Name of harbor, Menomonee, Mich.
Collection district, Superior, Mich.
Nearest light-house, Menomonee, Mich.

Arrivals and departures of vessels.

Class.	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers	194	57,191	3,854	200	56,981	3,901
Sailing vessels	397	125,962	2,630	398	126,381	2,625
Total	591	183,153	6,484	598	183,362	6,526

EXPORTS.

Articles.	Amount.		Articles.	Amount.	
	By water.	By rail.		By water.	By rail.
Bark ....cords.	1,000	5,000	Merchandise, general ....lbs..	150,000	50,000
Beer ....bbls..	1,500	520	Poles, telegraph..number.	1,000,000	500,000
Castings ....lbs..	100,000	150,000	Posts ....do...	2,000,000	1,000,000
Fish ....pkgs..	20,000	5,000	Potatoes ....bbls..	150	....
Hides ....number..	1,000	500	Rags ....lbs..	12,000	5,000
Iron ....lbs..	20,000	10,000	Shingles ....number..	20,000,000	20,000,000
Iron ore ....tons..	10,000	....	Slabs ....cords..	15,000	10,000
Iron, pig ....do...	2,000	....	Ties, railroad..number..	1,500,000	250,000
Laths ....number..	4,000,000	Ties	Wood ....cords..	....	3,000
Live stock ....do...	400	250	Wool ....lbs..	5,000	....
Lumber ....feet B. M..	400,000,000	20,000,000			
Machinery ....lbs.	100,000	....			

IMPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Apples ....bbls..	1,500	1,200	Lime ....bbls..	6,000	1,500
Barley ....bush..	1,000	5,000	Live stock ....number..	500	150
Beef ....lbs..	80,000	40,000	Machinery ....lbs..	25,000	....
Beer ....bbls..	1,200	700	Malt ....do...	55,000	200,000
Brick ....number..	2,500,000	20,000	Merchandise, general ....lbs..	300,000	160,000
Coal ....tons..	5,000	....	Oats ....bush..	112,000	40,000
Corn ....bush..	7,000	....	Oil ....bbls..	1,000	500
Dry goods ....tons..	650	150	Plaster, land ....tons..	100	250
Feed ....do...	4,000	3,000	Pork barrels ...number..	4,000	1,500
Flour ....bbls..	4,000	5,000	Provisions ....lbs..	150,000	140,000
Fruit ....lbs..	11,000	22,500	Salt ....do...	10,000	....
Groceries ....do...	300,000	100,000	Stone ....cords..	1,400	....
Hardware ....tons..	140	250	Tools, farm ....tons..	120	50
Hay ....do...	1,000	1,500	Wheat ....bush..	500	....
Wood ....cords..	6,000	....			

H H 8.

IMPROVEMENT OF OCONTO HARBOR, WISCONSIN.

Estimated cost (see Report of the Chief of Engineers for 1883, page 1646)....	$150 00
Appropriated	40 00

Approved project.—The extension to the 10-foot curve in Green Bay of two slab-piers built by the city of Oconto, the piers to be parallel and 150 feet apart, with a dredged channel between them 100 feet wide and 8 feet deep at the shore-line, increasing to a depth of 10 feet at the outer end of the piers; also dredging a channel about 2 miles long, 100 feet wide, and 8 feet deep at low water, from Section Street Bridge, in the city of Oconto, connecting the river at that point with the channel between the piers.

The first appropriation for this harbor was made in 1881, and work was begun in the ensuing year.

Under the appropriation of July 5, 1884, a contract was entered into with Schwarz & Berner, of Green Bay, Wis., for extending the piers 800 linear feet and building a pile protection for the south pier, parallel to and covering the outer 1,000 linear feet of same, on the south side.

During the past fiscal year, under this contract, the line of protection-piling was completed, with the exception of placing 120 linear feet of wales, and the work of pier extension was begun.

In September, 1884, a dredge belonging to the Fox River improvement was transferred to Oconto, and has removed from the channel 56,671 cubic yards of material. The total quantity dredged since the improvement begun is 111,451 cubic yards.

Included in this work is a cut 2,400 feet long, 60 feet wide, and 9 to 10 feet deep, forming a straight channel and cutting off a bend in the river about 3,500 feet in length.

The north pier is 1,100 feet long, and the south pier, built to a length of 1,900 feet, is but 1,850 feet long, a section of 50 feet length (No. 38) having been entirely carried away by ice in the winter of 1883–'84. This section will be rebuilt under a contract now in force, which will add 500 linear feet to the north pier and 300 feet to the south pier, making them respectively 1,600 feet and 2,150 feet long.

In other improvements in this district it has been customary for the United States to improve only the part of the harbor outside the shore-line, leaving that inside for the local authorities to work upon. There seems no reason why this harbor should be made an exception, especially as the commerce is small and, from its dependence on the lumber interests, probably temporary.

The channel is often used for booming and mooring logs and lumber-scows, and the piers, built in the cheapest practicable manner, are constantly receiving injuries from such use, the piles being frequently broken, and when not promptly replaced the slab filling washes out, endangering serious breaches in the piers.

That part of the piers built by the citizens was so poorly constructed that unless rebuilt or extensively repaired it will soon afford no protection and render the outside work unavailable.

Should Congress continue to make appropriations for this improvement, it would seem advisable that the funds be devoted to the completion of the work outside the shore-line and that the expenditures be made contingent on the work inside being carried forward by local interests in a satisfactory manner, in regard both to the amount of work and the rate of progress.

As bearing upon this question the report of Mr. Thomas E. Hutchings, inspector, is appended hereto.

Money statement.

July 1, 1884, amount available	$195 15
Amount appropriated by act approved July 5, 1884	15,000 00
	15,195 15
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,026 72
July 1, 1885, amount available	11,168 43
Amount (estimated) required for completion of existing project	110,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for pier extension at Oconto Harbor, Wisconsin, opened at engineer office, Milwaukee, Wis., at 10 *o'clock a. m., Tuesday, August* 26, 1884.

No.	Names and addresses of bidders.	White oak round piles (if required), per linear foot.	Round piles other than white oak, 41,400 linear feet, per linear foot.	White oak timber, 12,300 feet B. M., per M. feet B. M.	Pine timber 12 by 12 inches, 2,040 linear feet, per linear foot.	Pine timber 8 by 12 inches, 3,840 linear feet, per linear foot.	Pine plank, 8,000 feet B. M., per M. feet B. M.	Stone, 85 cords, per cord.	Slabs and edging, 1,300 cords, per cord.	Screw-bolts and tie-rods, 18,000 pounds, per pound.	Staples, 200 pounds, per pound.	Total approximate value of bid.
1	Hanson & Scove, Manitowoc, Wis	$0 24	$0 14½	$43 00	$0 25	$0 17	$16 00	$6 00	$1 95	$0 05	$0 05	$11,697 70
2	Christian Schwarz and Charles Berner, Green Bay, Wis	24	12	44 00	23	19½	12 00	5 00	1 60	4½	8	10,094 20
3	Greene's Dredging Company, O. B. Greene, president, Chicago, Ill.	32	18	40 00	28	20	18 00	5 00	2 00	6	8	13,458 20
4	Aaron F. Chapman, Robert H. Canfield, and Henry A. Canfield, Watkins, N. Y.*	22	18	30 00	27	20	24 00	5 00	1 50	5	5	12,496 80

* Received by express at 4.45 o'clock p. m., Tuesday, August 26, 1884.

REPORT OF MR. THOMAS E. HUTCHINGS, INSPECTOR.

MILWAUKEE, *Wis., July* 23, 1885.

n accordance with your instructions I have the honor to make the following Oconto Harbor, Wisconsin.

I. CONDITION OF PIERS.

North pier.—This is in good condition as far as built, except that the sand covering put on to protect it from sparks and fire has blown off from the six inner sections.

South pier.—This pier is covered with sand, except the 50 feet built this season, and is well protected from fire. Several piles have been broken off on the channel side by tugs and scows running into them. Two were broken off by Messrs. Holt & Balcom's tugs, and will be replaced by them; the others no one will acknowledge breaking.

The inner 600 feet of this pier were built by the city of Oconto, and need immediate repair. The piles on the channel side seem to have been driven from 3 to 4 feet apart, but at the present time there are intervals of from 10 to 30 feet, which were caused by tugs, scows, &c.; running into and breaking off the piles below the water surface. The remaining piles do not extend more than 2½ feet above water, and are in very bad condition. The filling, which is composed of edgings weighted with sand, extends above the pile heads. The current runs squarely against the inner end, and the only protection it has is one pile and the weight of the sand on the edgings.

II. CONDITION OF CHANNEL.

Between piers.—Is from 50 to 75 feet wide, commencing at the south pier, with an approximate depth of 8 feet. Tugs drawing 7 feet have no trouble in passing through it. The width between the piers is 150 feet.

Between piers and cut-off.—A channel 75 feet wide, with a depth varying from 9 to 9½ feet, for a distance of 2,450 feet from the inner end of the south pier, was dredged in 1884. It has not shoaled to any great extent, as tugs drawing 7 feet can easily pass through it.

Cut-off.—A cut was made in 1884, and 1885 commencing near Spies's Mill, and forming a channel about 2,000 feet long, 70 feet wide, and varying in depth from 4 to 10 feet (reduced depth) to the river below. The channel from Spies's Mill to Section Street Bridge will not exceed 3 feet, reduced depth.

III. OCCUPANCY OF PIERS AND CHANNEL.

The river near the cut-off is used by Messrs. Holt & Balcom for storing rafts of timber, leaving a space for tugs to pass through.

Tows of logs, composed of five or six rafts, are very often left in the cut at nights and over Sundays, and parties passing through are compelled to pass over the logs or push them aside.

The channel side of the north pier is used for making up tows of logs, which remain tied to the pier from three to four days at a time. Tugs do not tie up to this pier, as there is only 4 feet of water, reduced depth, at the outer end.

Tugs tie up to the channel side of the south pier, and very often remain over night.

Very respectfully, your obedient servant,

THOS. E. HUTCHINGS,
Inspector.

Col. J. W. BARLOW,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Hon. W. H. Young.]

Name of harbor, Oconto, Wisconsin.
Collection district, third.
Nearest light-house, Sturgeon Bay, Wisconsin.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	Number.	Tonnage.	Crews.	Number.	Tonnage.	Crews.
Steamers	63	3,150	315	68	3,400	340
Sailing-vessels	130	26,000	920	139	27,800	973
Total	193	29,150	1,235	207	31,200	1,313

Arrival and departure of vessels—Continued.

EXPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Apples............barrels..		600	Lumber ....feet, B. M..	34,000,000	42,000,000
Bark...............cords .		2,000	Machinery...... pounds..	40,000	
Beans ....bushels..		1,800	Merchandise, general lbs..	900,000	400,000
Beef ....pounds..		4,000	Poles, telegraph .number..		50,000
Beer ....barrels..		1,200	Posts ....do ...	42,000	410,000
Castings..........pounds..	20,000		Potatoes ....barrels..	400	
Chairs...........number..		800	Shingles.........number..	8,000,000	24,000,000
Fish ....packages..	15,000	15,000	Slabs ....cords..	800	1,400
Flour ....barrels..	6,000	4,000	Tools, farm .... tons..		80
Hardware............tons..		240	Ties, railroad....number..	100,000	250,000
Hides ....number..		2,000	Wood ....cords..		660
Lathes .... do....	8,000,000	7,000,000	Wool ....pounds..		8,000
Live stock...........do....	85	290	Rags ....do....		2,000

IMPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Apples............barrels..		700	Iron, &c ....pounds..	100,000	300,000
Barley............bushels..		4,000	Leather ....tons..		60
Beef ....pounds..	140,000	300,000	Lime ....barrels..	600	2,500
Beer ....barrels..		2,000	Live stock.......number..		3,800
Brick .... number..	340,000	27,000	Machinery ...... pounds..	200,000	600,000
Coal ....tons..	240	380	Merchandise, general.lbs..	10,000,000	20,000,000
Corn..............bushels..	13,000	32,000	Oil ....barrels..	600	2,500
Dry goods............tons..	870	4,000	Plaster, land.........tons..		200
Feed..................do	2,000	3,500	Pork barrels.....number..	800	4,000
Flour .... barrels..		3,100	Provisions ....pounds..	60,000	240,000
Fruit..............pounds..		600,000	Salt .... do ..		200,000
Groceries ....do....	2,300,000	3,700,000	Stone ....cords..	200	
Hardware............tons..	2,000	5,000	Wheat...........bushels..		125,000
Hay..................do....	1,000	1,000	Wood............. cords..	140	90

H H 9.

IMPROVEMENT OF PENSAUKEE HARBOR, WISCONSIN.

Estimated cost (see Report of Chief of Engineers, 1883, page 1652)	$50,000
Appropriated	15,000

The first appropriation for the improvement of this harbor was made by act of Congress passed August 2, 1882, the river and harbor act containing an item of $10,000 for the purpose.

The project consisted in continuing a slab-pier which had been built by private enterprise until it should reach the 10-foot curve in Green Bay, and in dredging a channel south of this pier to a depth of 10 feet and width of 100 feet, which should connect the deep water in the river with the deep water in the bay.

The present condition of the harbor is the same as when my last annual report was written, viz:

The entire length of the pier is 2,900 feet, the inner 1,600 feet having been built by private parties, and the remaining 1,300 linear feet having been built by the United States.

The channel south of this pier has been dredged by United States dredges to a depth of 10 feet and width of 25 feet.

There were no operations during the past fiscal year.

No part of the appropriation of $5,000 made July 5, 1884, has been expended.

An investigation made in the fall of 1884 developed the fact that there were absolutely no commercial or navigation interests to be benefited by continuing the improvement, and a recommendation that the expenditure of the money appropriated be suspended until satisfactory evidence was received of the necessity of its expenditure, was concurred in by the Chief of Engineers and approved by the Secretary of War.

No money is asked for continuing this improvement.

Money statement.

July 1, 1884, amount available	$815 80
Amount appropriated by act approved July 5, 1884	5,000 00
	5,815 80
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	40 05
July 1, 1885, amount available	5,775 75
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	35,000 00

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from H. G. Morgan.]

Name of harbor, Pensaukee, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Tail Point, Wisconsin.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers	41	7,255	41	41	7,255	41

EXPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Beef .... barrels	....	5,570	Machinery .... pounds	....	3,000
Butter .... pounds	....	200	Merchandise, general .... do	....	10,000
Fish .... packages	....	1,000	Posts .... number	....	120,000
Hides .... number	....	2,000	Potatoes .... barrels	....	40
Live stock .... do	....	5	Shingles .... number	....	350,000
Lumber .... feet, B. M.	430,000	117,000			

IMPORTS.

Feed .... tons	....	16,120	Merchandise, general, pounds	....	204,945
Flour .... barrels	....	5,000			

H H 10.

IMPROVEMENT OF GREEN BAY HARBOR, WISCONSIN.

Estimated cost of present project (see Report of Chief of Engineers, 1881, page 2069)	$135,000
Appropriated	98,000

The total appropriations for the improvement of this harbor amount to $270,550, most of which has been applied to dredging.

The maintenance of a good channel here is important to the navigation of Fox River.

The present project consists in dredging a channel 200 feet wide and 14 feet deep at low water, extending from the mouth of Fox River to deep water in Green Bay, a distance of 2 miles, including a revetted cut through Grassy Island.

At present this channel is 175 feet wide, and from 13 to 14 feet deep. The revetment through Grassy Island, 705 feet long on the east side and 620 feet long on the west side, is not in good condition, and will require the renewal of most of the superstructure.

During the past fiscal year two United States dredges removed from the channel 49,402 cubic yards of material; the time occupied by both dredges being ninety-seven days.

The total quantity dredged since the improvement began is 753,475 cubic yards.

In May of the present year a contract was entered into with the Green Bay Dredge and Pile Driver Company for dredging to the extent of $3,000, at 26 cents per cubic yard.

Work on this contract had not been commenced at the close of the fiscal year.

When this contract is finished there will remain on hand a sufficient sum to make the needed repairs to the revetments.

With the money asked for the fiscal year ending June 30, 1887, it is contemplated to dredge the channel to the dimensions called for by the present project.

Money statement.

July 1, 1884, amount available	$3,863 67
Amount appropriated by act approved July 5, 1884	10,000 00
	13,863 67
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	5,008 73
July 1, 1885, amount available	8,854 94
Amount (estimated) required for completion of existing project	37,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	37,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for dredging at harbor at Green Bay, Wis., opened at engineer office, Milwaukee, Wis., at 11 o'clock a. m., Wednesday, April 22, 1885.

No.	Names and addresses of bidders.	Rate per cubic yard.	Total approximate value of bid.
1	Truman & Cooper, Manitowoc, Wis	$0 29	$3,480
2	Green's Dredging Company, O. B. Green, president, Chicago, Ill	31	3,720
3	Green Bay Dredge and Pile-Driver Company, Levy B. Godfrey, president, Green Bay, Wis	26	3,120

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Mr. D. I. Follett, deputy collector of customs.]

Name of harbor, Green Bay, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Grassy Island, Wisconsin.

Arrival and departure of vessels.

	Arrivals.		Departures.	
	No.	Tonnage.	No.	Tonnage.
Steamers	193	29, 801	208	31, 166
Sailing-vessels	162	19, 291	173	20, 114
Total	355	49, 092	381	51, 180

H H 11.

HARBOR OF REFUGE AT ENTRANCE OF STURGEON BAY CANAL, WISCONSIN.

Estimated cost (see Report of Chief of Engineers, 1874, I, page 141)	$180, 000
Appropriated	160, 000

The project of constructing a harbor of refuge inclosing the Lake Michigan entrance to the Sturgeon Bay Canal was adopted in 1871, and the pier work was completed in the fall of 1884.

The harbor is inclosed between two piers, each 1,200 feet long, beginning at equal distances, respectively, north and south from the lake entrance to the Sturgeon Bay and Lake Michigan Ship-canal, 850 feet apart at the shore-line, converging to a distance of 235 feet from each other, with detached piers extending 150 feet further, the latter being so placed that the entrance is widened to 335 feet. The outer end of each detached pier is connected with the outer end of the adjacent main structure by 165 feet of fender piling.

The project embraces the formation of a dredged channel of indefinite width, 16 feet deep, extending from the harbor entrance to the canal entrance.

During the past fiscal year, by hired labor and the purchase of material in open market, the guide-piling at the entrance to the harbor was completed; 350 feet of superstructure was built over the south pier by bolting two courses of timber thereon, the stone filling in both piers was completed, and the piers were riprapped and planked.

This completed the work of construction in accordance with the project, though considerable dredging is still to be done.

As stated in my last annual report, the advantages expected to accrue to vessels navigating Lake Michigan, when the construction of a harbor of refuge at this place was projected, have not been entirely realized. It is reported that in tempestuous weather the harbor is too limited, and does not afford sufficient security to vessels seeking its shelter, often necessitating their passage through the canal to avail themselves of the superior advantages afforded by the natural harbor of Sturgeon Bay.

Tolls are exacted by the canal company from vessels using the canal either as an avenue of safety or for purposes of trade.

As the construction by the United States of a harbor of refuge at the lake entrace of the canal is a direct benefit to the canal itself, it would seem no more than just that vessels seeking safety in the harbor, and compelled to pass through the canal to secure such safety, should be exempt from paying toll to the canal company.

It is therefore recommended that such legislation be accomplished as shall render the canal free to vessels that may be compelled to use it through stress of weather.

It is probable that when all the dredging contemplated shall have been done, the necessity of vessels passing through the canal to seek the protection of Sturgeon Bay will be diminished.

It is contemplated to apply the money asked for the fiscal year ending June 30, 1887, to dredging, and repairs, if needed.

Money statement.

July 1, 1884, amount available	$1,105 90
Amount appropriated by act approved July 5, 1884	10,000 00
	11,105 90
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,319 50
July 1, 1885, amount available	4,786 40
Amount (estimated) required for completion of existing project	20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Hon. E. S. Minor, superintendent.]

Name of harbor, harbor of refuge at entrance of Sturgeon Bay Canal, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, entrance to harbor.

Number of vessels and their tonnage which passed through the Sturgeon Bay and Lake Michigan Ship-canal during the year ending December 31, 1884.

	Number.	Tonnage.
Steamers	2495	183,265
Sailing-vessels	1092	217,535
Tow barges	968	320,431
Total	4555	721,231

H H 12.

IMPROVEMENT OF AHNEPEE HARBOR, WISCONSIN.

Estimated cost (see Report of Chief of Engineers, 1876, II, pages 346–359)	$175,000
Appropriated	140,000

Project of improvement.—The formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 12 feet deep at low water, to be formed by the construction of two piers extending from the shore line to the 18-foot curve in the lake; also blasting and dredging rock from the river bed near its mouth for a distance of 750 feet.

During the past fiscal year the work of rock removal and pier construction was done by hired labor, with the following result:

Two cribs, which had been partially built, and one which had been built to full height under former appropriations, were completed and sunk, and two cribs were entirely built and sunk in extension of the piers.

In accordance with a modification of the original project, approved September 27, 1884, this new work was placed 50 feet further from the center line of the channel than the old piers, and will afford, when completed, a 200-foot entrance between the pier-heads.

The entire length of the north pier is now 900 feet, and of the south pier 1,125 feet.

Superstructure was completed over 300 linear feet of the south pier, and over 150 linear feet of the north pier.

Rock removal.—During the past fiscal year, 6,413 cubic yards of rock were blasted and removed from the river bed, and 4,478 cubic yards of sand were dredged. This work was carried on simultaneously with the pier work, and the rock blasted from the channel was utilized for crib filling and riprap, at a cost (including all expenses, and estimated depreciation of plant) of $6.35 per cord, divided as follows:

	Per cubic yard.	Per cord.
Drilling and blasting	$0 $75\frac{2}{10}$	$3 59
Dredging	$37\frac{4}{10}$	1 77
Placing in pier	$21\frac{84}{100}$	99
Total	1 34	6 35

The cost of dredging 4,478 cubic yards of sand is included in the cost of dredging rock as given above.

The total expenditure during the last fiscal year amounted to $13,772.63, as follows:

Drilling and blasting	$4,979 16
Dredging	1,773 83
Pier construction, stone filling	1,276 20
Pier construction, timber work	4,837 10
Contingent expenses	906 34
	13,772 63

In a report on occupation and use of piers, &c., called for by General Order No. 13, Headquarters Corps of Engineers, July 23, 1884, the following facts in relation to this harbor were presented:

> The south pier at this harbor is used as a wharf by the steamboat which stops here about six times a week. Nearly all the freight handled at the place passes over this pier. A warehouse, a fish market, and other buildings, as shown on the accompanying map of the harbor, have been built just back of this pier. The owner of these buildings, who is also the proprietor of the land on both sides of the harbor as far up as the Second Street Bridge, collects wharfage upon all freights which pass over the pier; this wharfage being equal, in some cases, to the freight from Manitowoc to Ahnepee. He has even presented bills for wharfage on Government supplies.
>
> This person has, in fact, an entire monopoly of the business of the harbor, and must continue to have until the channel is carried up the river beyond the limits of his property.
>
> This pier is being seriously damaged by the demands made upon it as a landing pier and freight wharf, and such use of it should be discontinued as soon as suitable wharfage can be provided higher up.
>
> The bridge at Second street prevents the harbor above being reached by any but the smaller-sized vessels, as the draw opening is but 35 feet in width, and the depth in the channel but 7 feet.
>
> * * * * * * *
>
> Should the Government undertake to enlarge this part of the channel to the same dimensions as are now being provided below, the citizens will either remove the bridge to Fourth street or rebuild it on its present site, with a draw opening of sufficient width to accommodate all vessels which will be likely to use this harbor.
>
> An obstruction known as the Citizens' Pier remains near the middle of the harbor as a temporary barrier against sand which is driven through the north pier into the channel. This old pier will be removed by the citizens when requested to do so by the United States.

With the funds asked for the fiscal year ending June 30, 1887, it is proposed to continue the work of blasting and pier construction.

Money statement.

July 1, 1884, amount available	$92 71
Amount appropriated by act approved July 5, 1884	15,000 00
	15,092 71
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	13,772 63
July 1, 1885, amount available	1,320 08
Amount (estimated) required for completion of existing project	35,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	35,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

DETAILS OF COST OF WORK AT AHNEPEE HARBOR, WISCONSIN, DURING THE FISCAL YEAR ENDING JUNE 30, 1885, INCLUDING ESTIMATED DEPRECIATION OF PLANT.

Drilling and blasting:	
Net expenditure	$4,979 16
Less value of explosives paid for and remaining on hand	631 26
	4,347 90
Proportion of contingent expenses	370 79
Estimated depreciation of plant, 10 per cent. on $1,500	150 00
Total cost for 6,413 cubic yards	4,868 69

or 75.9 cents per cubic yard.

Dredging:	
Net expenditure	1,773 83
Proportion of contingent expenses	127 14
Depreciation of dredge plant, estimated at $200 per month, for two and one-half months	500 00
Total cost of dredging 6,413 cubic yards of rock	2,400 97

or 37.4 cents per cubic yard.

In addition to the rock dredged, 4,478 cubic yards of sand were also removed; as this was a necessary part of the rock removal, its cost has been included above.

Placing rock in piers:	
Transporting, handling, and placing 6,413 cubic yards of rock in cribs, and as riprap, net expenditure	$1,276 20
Proportion of contingent expenditures	73 08
	1,349 28

or 21.04 cents per cubic yard, or 99.73 cents per cord.

Pier extension:

(1) Two cribs, 50′ by 20′ by 12¼ feet, were built, sunk, filled, and planked.

(2) Two cribs, each 50′ by 20′ by 12¼ feet, which had been partially built in 1882, were completed by adding four courses of timber to each, and were sunk, filled, and planked.

(3) One crib, 50′ by 20′ by 12¼ feet, which had been built to full height in 1882, was sunk, filled, and planked.

(4) Four hundred and fifty linear feet of superstructure was built up an average of six courses, filled and planked.

The total cost of the work was:

For timber and plank, bolted in place	$4,837 10
Less cost of 75,000 feet, B. M., of timber at $8 per 1,000 feet, B. M., purchased and on hand	600 00
	4,237 10
Stone filling	1,349 28
Proportion of contingent expenses	335 33
	5,921 71

A comparison of the actual cost of the pier work with the estimated cost of same if done by contract, assuming as the contract prices an average of the lowest bids received August 26, 1884, for similar work at Menomonee and Two Rivers harbors, Wisconsin, shows that the cost of the work was less than one-half of what it would have been if done by contract, viz:

Actual cost by hired labor	$5,921 71
Estimated cost by contract	12,515 21
Saving	6,593 50

This remarkable saving is due to the following circumstances:

(1) The stone used for filling was refuse, blasted from the channel, and its removal was necessary, even had there been no pier-work in progress. The cost of placing this stone, after it had been dredged, was less than $1 per cord. Should the entire cost of drilling, blasting, dredging, and placing the stone in the piers be considered as a legitimate expense of pier construction, it would still not have been excessive, viz, $6.35 per cord. The contract price at Sheboygan is $7 per cord.

(2) The second item in importance is timber, on which the saving over estimated contract prices was $1,107.06.

This timber was cut from the United States reservation at Sturgeon Bay, and delivered at Ahnepee, under an agreement dated August 12, 1882, at the rate of $8 per thousand feet, board measure.

(3) The market price of iron was very low during the summer, and this circumstance was taken advantage of by purchasing in open market.

COMMERCIAL STATISTICS FOR YEAR ENDING DECEMBER 31, 1884.

[Obtained from Mr. M. T. Parker.]

Name of harbor, Ahnepee, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Sturgeon Bay Canal, Wisconsin.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	Number.	Tonnage.	Crews.	Number.	Tonnage.	Crews.
Steamers	280	145,700	5,040	278	145,550	5,028
Sailing-vessels	325	40,150	1,600	322	40,000	1,585
Total	605	185,850	6,640	600	185,550	6,613

EXPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Bark .... cords	2,400	Lumber .... feet, B.M.	1,500,000
Beef .... pounds	95,000	Merchandise, general .... pounds	50,000
Beer .... barrels	190	Oats .... bushels	10,000
Brick .... number	80,000	Peas .... do	28,000
Butter .... pounds	150,000	Posts .... number	250,000
Cheese .... do	30,000	Potatoes .... bushels	5,500
Doors, &c .... number	350	Rags .... pounds	30,000
Eggs .... dozen	5,000	Rye .... bushels	8,000
Fish, fresh .... pounds	180,000	Shingles .... number	500,000
Flour .... barrels	375	Telegraph poles .... do	2,000
Hardware .... tons	200	Ties, railroad .... do	850,000
Hay .... do	200	Wheat .... bushels	350,000
Hides .... number	2,000	Wood .... cords	4,300
Leather .... tons	48	Wool .... pounds	5,000
Live-stock .... number	650		

Arrival and departure of vessels—Continued.

IMPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Apples .... barrels..	750	Leather .... tons..	7
Beef .... pounds..	4,850	Live-stock .... number..	300
Beer .... barrels..	125	Lumber .... feet, B. M..	1,500,000
Coal .... tons..	825	Machinery .... pounds..	2,500,000
Dry goods .... do ...	390	Merchandise general .... do....	5,500,000
Feed .... do ...	430	Oil .... barrels..	400
Flour .... barrels..	6,500	Plaster, land .... tons..	130
Fruit .... pounds..	25,000	Pork barrels .... number..	450
Groceries .... do....	1,000,000	Provisions .... pounds..	200,000
Hardware .... tons..	390	Salt .... do....	280,000
Hides .... number..	2,100	Shingles .... number..	500,000
Iron and steel .... pounds..	200,000	Whisky .... barrels..	175

H H 13.

IMPROVEMENT OF KEWAUNEE HARBOR, WISCONSIN.

Estimated cost (see Report of the Chief of Engineers, 1881, page 2084)....		$200,000 00
Appropriated by the United States	$35,000 00	
Appropriated by local authorities	8,042 72	
		43,042 72

A survey of this harbor was ordered by act of Congress approved June 14, 1880, and the first appropriation was made March 3, 1881.

The project of improvement consists in the formation of a channel from a point about 2,000 feet south of the mouth of Kewaunee River, through a spit about 300 feet wide, affording communication between the river and Lake Michigan. From the lake end of this cut two parallel piers are to be constructed, extending to the 18-foot curve, with dredging between and through the cut, to a depth of 14 feet.

Under the appropriation of July 5, 1884, a contract was entered into with Schwarz & Berner, of Green Bay, Wis., for building 500 linear feet of pile pier.

The present length of the north pier is 700 feet, and the depth of water at its outer end is 9 feet. The length of the south pier is 275 feet; the existing contract, when completed, will add 500 feet to its length, making it 775 feet long, with a depth of water at its terminus of about 10 feet.

Work under the contract was begun near the close of the fiscal year, but had not progressed sufficiently to increase the length of the completed pier work as given above.

The two United States dredges will begin work at this harbor during the present season, and it is expected that by the close of navigation a 12-foot channel will be dredged between the piers and through the cut to the river bend.

The inspector at Kewaunee reports that private parties have begun to build docks and are preparing to erect warehouses for the transaction of business in expectation of the opening of the new channel.

It is doubtful if the local business at this harbor would in itself justify the completion of the improvement; it will, however, afford protection for vessels in stress of weather, and as a harbor of refuge its completion is desirable.

Should an appropriation be made for the fiscal year ending June 30, 1887, it is contemplated to expend it in further pier construction and dredging.

Money statement.

July 1, 1884, amount available	$875 24
Amount appropriated by act approved July 5, 1884	18,000 00
	18,875 24
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,521 33
July 1, 1885, amount available	17,353 91
Amount (estimated) required for completion of existing project	156,957 28
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for pier extension at Kawaunee Harbor, Wisconsin, opened at Engineer's Office, at 10 o'clock a. m., Tuesday, August 26, 1884.

Number.	Names and addresses of bidders.	White oak round piles (if required), per linear foot.	Round piles, other than white-oak, 16,250 linear feet, per linear foot.	Norway sheet-piling, 75,000 feet, B. M., per M feet.	White oak timber, 30,750 feet, B. M., per M. feet.	Pine timber, 12 by 12 inches, 1,000 linear feet, per linear foot.	Pine timber, 6 by 12 inches, 1,500 linear feet, per linear foot.	Pine plank, 5,000 feet, B. M., per M feet.	Stone, 560 cords, per cord.	Screw-bolts and tie-rods, 13,000 pounds, per pound.	Spikes, 600 pounds, per pound.	Total approximate value of bid.
1	Hanson & Scove, Manitowoc, Wis.	$0 23	$0 18½	$30 00	$43 00	$0 24	$0 13	$16 00	$6 00	$0 05	$0 05	$11, 123 50
2	Christian Schwarz and Charles Berner, Green Bay, Wis.	25	18	26 00	43 00	24	15	14 00	5 25	04½	04½	10, 284 25
3	Green's Dredging Company, O. B. Green, president, Chicago, Ill.	32	23	32 00	45 00	32	22	20 00	5 75	06	07	12, 213 25

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Joseph Duvall & Co.]

Name of harbor, Kewaunee, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Twin River Point, Wisconsin.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	Number.	Tonnage.	Crews.	Number.	Tonnage.	Crews.
Steamers	180	80,000	5,400	180	80,000	5,400
Sailing-vessels	50	7,500	250	50	7,500	250
Total	230	87,500	5,650	230	87,500	5,650

Exports and imports by water.

EXPORTS.

Articles.	Amount.	Articles.	Amount.
Bark ....cords..	2,000	Oats ....bushels..	18,000
Beans........bushels..	200	Peas ....do....	25,000
Brick........number..	200,000	Posts ....number..	12,000
Butter........pounds..	150,000	Potatoes........barrels..	1,000
Cheese ....do....	25,000	Rags ....pounds..	20,000
Eggs........dozen..	10,000	Rye........bushels..	5,000
Fish........packages..	100	Shingles ....number..	3,000,000
Flour........barrels..	15,000	Tallow ....pounds..	7,000
Hay ....tons..	300	Ties, railroad ....number..	50,000
Hides........number..	3,200	Wheat........bushels..	150,000
Lumber,........feet, B. M..	2,000,000	Wood ....cords..	500
Merchandise, general ....pounds..	50,000	Wool........pounds..	5,000

IMPORTS.

Apples ....barrels..	500	Leather ....tons..	20
Beer ....do....	400	Machinery ....pounds..	2,000,000
Coal........tons..	100	Merchandise, general ....do....	1,000,000
Corn........bushels..	8,000	Oil........barrels..	500
Dry goods ....tons..	500	Plaster, land ....tons..	100
Fruit........pounds..	10,000	Pork-barrels ....number.	400
Groceries ....do....	1,000,000	Provisions ....pounds..	100,000
Hardware........tons .	300	Salt ....do....	1,200
Iron and steel ....pounds..	100,000		

H H 14.

IMPROVEMENT OF TWO RIVERS HARBOR, WISCONSIN.

Estimated cost (see Report of the Chief of Engineers, 1871, page 123)...	$265,588 80
Appropriated	198,000 00

The project for the improvement of this harbor, adopted in 1870, consists in the construction of two parallel piers extending from the river mouth to the 18-foot curve in the lake, and dredging between them to a depth of 12 feet. These piers are now respectively 1,810 and 1,710 feet long. For a length of about 1,000 feet from the shore-line of 1870 they are composed of piles, and the distance between them is 270 feet; beyond this they are composed of cribs, and the width of the channel is reduced to 230 feet, gradually expanding to 250 feet at the outer entrance.

During the past fiscal year a United States dredge removed from the channel 33,395 cubic yards of material; of this quantity 5,849 cubic yards were removed from the channel above the inner ends of the piers under an arrangement entered into in 1881 with the city of Two Rivers, as explained in the Annual Report of the Chief of Engineers for 1882, pages 2143, 2144.

In accordance with this understanding the United States was to dredge 1 cubic yard from the inner channel for every 15 cents expended by the city of Two Rivers in paying the running expenses of a United States dredge while engaged in restoring the channel between the piers, the case being urgent, and there being no funds available from the appropriation at the time.

Three thousand two hundred and twenty-five dollars and fifty-one cents were paid by the city for this work, entitling it to the removal of 21,704 cubic yards inside. Of this quantity the United States dredges have since removed, in 1882, 11,214 cubic yards, and during the past fiscal year 5,849 cubic yards, a total of 17,063 cubic yards, leaving 4,641 cubic yards yet to be removed under this arrangement. This work has been done at times when dredges could not work outside, in consequence of rough weather.

Under the appropriation of $8,000 made July 5, 1884, a contract was entered into with Truman & Cooper, of Manitowoc, Wis., for completing the superstructure over 700 linear feet of the piers, and filling and planking 150 linear feet additional. This contract was finished in October, 1884.

The channel has now a depth of from 10 to 12 feet for a width of 80 feet.

It is proposed to apply a part of the balance now on hand to dredging the channel to the required depth of 12 feet.

The commerce of this harbor is merely nominal, nearly all the freighting being done by rail.

The piers are in very fair condition, and terminate in 14.5 feet depth of water. With the funds now available the channel can be dredged to a depth of 12 feet, which is sufficient for the commercial needs of the place.

It is not deemed necessary, therefore, to urge an immediate completion of the original project, and no appropriation is asked for the next fiscal year.

Money statement.

July 1, 1884, amount available	$4,846 51
Amount appropriated by act approved July 5, 1884	8,000 00
	12,846 51
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	9,641 44
July 1, 1885, amount available	3,205 07
Amount (estimated) required for completion of existing project	67,588 80
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for pier extension at Two Rivers Harbor, Wisconsin, opened at engineer office, Milwaukee, Wis., at 10 o'clock a. m., Tuesday, August 26, 1884.

Names and addresses of bidders.	Pine timber, 12 by 12 inches, per linear foot, 10,000 linear feet.	Pine plank, per M feet, B M., 25,000 feet B. M.	Stone, per cord, 400 cords.	Drift-bolts, per pound, 10,000 pounds.	Screw-bolts, per pound, 200 pounds.	Spike, per pound, 1,500 pounds.	Relaying 8,000 feet, per foot B. M., B. M. pine plank.	Total approximate value of bid.
Hanson & Scove, Manitowoc, Wis	$0 28	$16 00	$6 50	$0 04	$0 05	$0 05	$3 00	$6,309 00
Truman & Cooper, Manitowoc, Wis	20	15 00	6 25	03	05	04	2 50	5,265 00
Charles Simons, Two Rivers, Wis	28	17 00	7 50	$2\frac{9}{10}$	03	03	3 00	6,590 00

List of materials and labor used at Two Rivers Harbor, Wisconsin, in building 200 *linear feet of superstructure six courses high, and filling and planking same; in building* 500 *linear feet of superstructure two courses high, and filling and planking* 150 *linear feet of superstructure.*

[Under contract with Truman & Cooper, dated September 20, 1884.]

	200 linear feet, six courses, filled and planked.	500 linear feet, two courses, filled and planked.	150 linear feet, filled and planked, previously built full height.	Price.	Cost.
Pine timber, 12 by 12 ....linear feet..	5, 711	4, 738	....	$0 20	$2, 089 80
Pine plank relaid ....feet, B. M..	3, 286	8, 217	2, 465	2 50	34 92
Pine plank, new ....feet, B. M..	6, 640	16, 600	4, 984	15 00	423 36
Stone ....cords..	182. 9	158. 5	64. 5	6 25	2, 536 87
Drift-bolts .... pounds..	5, 746	4, 802	....	03	316 44
Spike ....do....	392	985	295	04	66 88
	$2, 581 20	$2, 391 23	$495 84	....	5, 468 27

Cost per linear foot of superstructure:

Six courses high, filled and planked	$12 90
Two courses high, filled and planked	4 78
Filling and planking only	3 30

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Henry Mann.]

Name of harbor, two Rivers, Wis.
Collection district, Milwaukee, Wis.
Nearest light-house, Twin River Point, Wisconsin.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	Number.	Tonnage.	Crews.	Number.	Tonnage.	Crews.
Steamers	260	16, 432	1, 108	258	16, 120	1, 085
Sailing vessels	135	10, 340	706	134	10, 116	690
Total	395	26, 772	1, 814	892	26. 236	1, 775

EXPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Apples............barrels..	1, 500	660	Lime.............barrels..	....	305
Bark ....cords..	2, 556	....	Live-stock .... number..	....	750
Barley............bushels..	9, 542	9, 542	Lumber........feet, B. M..	3, 250, 000	5, 000, 000
Beans............... do....	....	445	Machinery.......pounds..	....	150, 000
Beef .... pounds..	24, 000	21, 850	Merchandise, general do...	....	795, 000
Beer ....barrels..	6, 405	8, 532	Oats ....bushels..	13, 400	24, 560
Butter ....pounds..	18, 562	5, 400	Oil .... barrels..	57	350
Castings ....do ...	....	80, 500	Peas..............bushels..	2, 240	15, 250
Chairs........... number..	15, 800	125, 178	Posts ....number..	16, 000	... ..
Cheese............pounds..	16, 450	10, 540	Potatoes ....barrels..	7, 050	4, 238
Corn ....bushels..	14, 300	540	Rags ....pounds..	......	4, 600
Doors, &c ....number..	6, 500	180, 000	Rye...............bushels..	9, 054	2, 300
Eggs ....dozen..	8, 030	300	Shingles.........number..	3, 500, 000	35, 000
Fish ....packages..	43, 500	953	Slabs .... cords..	24, 000	....
Flour ....barrels..	8, 400	10, 500	Tallow...........pounds..	7, 000	450
Furniture..........pieces..	10, 840	82, 556	Tools, farm .... tons..	....	350
Hardware............tons..	9	28	Wheat ....bushels .	212, 545	54, 000
Hay ....do ...	950	...	Whisky .... barrels..	....	85
Hides.............number .	1, 500	3, 800	Wood ....cords..	2, 450	....
Iron ....pounds..	42, 000	71, 000	Wooden-ware .... dozen..	10, 540	159, 400
Laths ....number..	120, 000	55, 000	Wool ....pounds..	....	5, 400
Leather..............tons..	532	468			

Arrival and deparure of vessels—Continued.

IMPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Apples .... barrels..	24,000	650	Iron and steel.... pounds..	145,000	135,400
Bark .... cords..	1,550	24,050	Lime .... barrels..	450	....
Barley .... bushels..	....	70,500	Live-stock .... number..	1,540	430
Beef .... pounds..	112,000	4,560	Logs .... feet..	10,000,000	....
Beer .... barrels..	3,680	1,230	Machinery .... pounds..	140,000	121,000
Brick .... number..	1,145,400	....	Merchandise, general. do...	540,000	680,000
Coal .... tons..	5,460	3,400	Oil .... barrels .	1,500	25,050
Corn .... bushels..	32,000	45,200	Plaster, land .... tons..	700	1,500
Dry goods .... tons..	....	200	Pork barrels .... number..	650	400
Feed .... do....	350	400	Provisions .... pounds .	250,000	2,050
Flour .... barrels .	2,354	10,400	Salt .... do....	112,000	7,500
Fruit .... pounds..	18,400	5,400	Shingles .... number..	1,480,000	....
Groceries .... do....	355,600	840,000	Stone .... cords..	1,400	....
Hardware .... tons..	28	320	Wheat .... bushels..	....	75,000
Hay .... do....	700	....	Wine .... barrels..	....	1,800
Hides .... number..	3,540	3,050	Wood .... cords..	780	15,000

H H 15.

IMPROVEMENT OF MANITOWOC HARBOR, WISCONSIN.

Estimated cost (see Report of the Chief of Engineers, 1881, page 2094).....	$308,182 54
Appropriated	276,820 00

Approved project.—The construction of two parallel crib-piers, 250 feet apart, extending from the river mouth to the 18½-foot curve in Lake Michigan, and dredging a channel 14 feet deep between the inner ends of the piers, increasing to 18 feet depth at the outer entrance.

The first appropriation for the improvement of this harbor was made in 1852; the system of improvement adopted at that time, though modified in some respects since, being substantially the same as that now in progress.

Under the appropriation of $10,000 made July 5, 1884, proposals were invited for extending the north pier 250 feet by sinking five cribs, each 50 feet long by 24 feet wide. The bids proving lower than was anticipated, a contract was entered into with Truman & Cooper, of Manitowoc, Wis., for sinking the five cribs contemplated, and in addition thereto covering them with superstructure.

The cribs were sunk last fall, and after being allowed to settle during the winter the superstructure was built over them during April and May of this year.

This work completed the north pier, including the pier-head, in accordance with the existing project. Its length is 1,970 feet.

The south pier is 1,650 feet long, and is to be continued 250 feet farther to reach the 18½-foot curve. When this is done the pier-heads will be opposite each other.

This is one of the most important harbors on Lake Michigan north of Milwaukee. The ship-yards and machine-shops have diverted considerable trade from Chicago and Milwaukee, the owners of many vessels preferring to have them repaired at Manitowoc rather than at other lake ports.

The hull of the United States tug Dione, belonging to the Engineer Department, was repaired here during the winter and spring, under authority granted by letter from the Chief of Engineers, January 9, 1885.

Both piers and the channel are in good condition; the latter has a depth of 14 feet for a width of 150 feet.

The appropriation asked for the fiscal year ending June 30, 1887, should be expended in completing the project by extension of the south pier, and by dredging and repairs if needed.

Money statement.

July 1, 1884, amount available	$1,839 29
Amount appropriated by act approved July 5, 1884	15,000 00
	16,839 29
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	15,400 04
July 1, 1885, amount available	1,439 25
Amount (estimated) required for completion of existing project	31,362 54
Amount that can be profitably expended in fiscal year ending June 30, 1887	31,000 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for pier extension at Manitowoc Harbor, Wisconsin, opened at engineer office, Milwaukee, Wisconsin, at 10 o'clock, a. m., Tuesday, August 26, 1884.

Number of proposals.	Names and addresses of bidders.	Pine timber, 12 by 18 and 12 by 12 inches, per linear foot, 10,000 linear feet.	Hemlock timber, 12 by 18 and 12 by 12 inches, per linear foot, 13,000 linear feet.	Pine plank, per M feet B. M., 19,000 feet B. M.	Stone, per cord, 725 cords.	Drift bolts, per pound, 18,000 pounds.	Screw bolts, per pound, 4,600 pounds.	Spikes, per pound, 600 pounds.	Total approximate value of bid.
1	Hanson & Scove, Manitowoc, Wis	$0 28	$0 25	$15 00	$6 50	$0 04	$0 05	$0 05	$12,027 50
2	Greenleaf S. Rand, Manitowoc, Wis	25	25	18 00	7 25	03	05	05	12,148 25
3	Christopher H. Starke, Milwaukee, Wis	†32	(*)	25 00	8 50	03½	06	05	14,933 50
4	Truman & Cooper, Manitowoc, Wis	22	20	13 00	6 25	03	05	04	10,372 25
5	Christian Schwarz and Charles Berner, Green Bay, Wis	25	23	14 00	6 50	03½	04	04	11,306 50

* No bid received for hemlock timber. † 32 cents per linear foot for 23,000 linear feet.

List of material and labor used at Manitowoc Harbor, Wisconsin, in the construction of five cribs, each 50 by 24 by 16½ feet, and 250 linear feet of superstructure over same, averaging 4½ feet in height.

[Under contract with Truman & Cooper, dated September 20, 1884.]

	Quantity.	Price.	Cost.
Pine timber, 12 by 12 inches ... linear feet	28,545	$0 22	$6,279 90
Pine plank ... feet B. M.	18,912	13 00	245 86
Stone ... cords	1,118¾	6 25	6,992 18
Drift-bolts ... pounds	24,161	03	724 83
Screw-bolts ... do	4,800	05	240 00
Spike ... do	1,325	04	53 00
			14,535 77

Cost of one crib, with superstructure	$2,907 15
Cost per linear foot	58 14

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from George B. Burnet, deputy collector of customs.]

Name of harbor, Manitowoc, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Manitowoc, Wisconsin.

Arrival and departure of vessels..

	Arrivals.			Departures.		
	Number.	Tonnage.	Crews.	Number.	Tonnage.	Crews.
Steamers	572	244, 660	16, 041	584	245, 099	16, 090
Sailing-vessels	361	38, 003	1, 541	369	40, 597	1, 583
Total	933	282, 663	17, 582	953	285, 696	17, 673

EXPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Bark ... cords..		50	Machinery pounds		638, 900
Beer ... barrels..		3, 000	Merchandise, general, packages	68, 337	
Butter ... pounds..	132, 575	57, 850	Oats ... bushels..	48, 272	4, 500
Brick ... number..	804, 000	342, 000	Oil ... barrels..		130
Cheese ... pounds..	330, 300	727, 630	Peas ... bushels..	95, 817	47, 310
Coal ... tons..		400	Plaster, land ... tons..		120
Eggs ... dozen..	83, 420	17, 000	Poles, telegraph . number..	300	
Fish ... pounds..	845, 300		Posts ... do ..	2, 600	
Flour ... barrels..	37, 600	8, 125	Potatoes ... bushels .	3, 310	2, 600
Feed ... tons..	1, 475	8	Rags ... pounds..	144, 600	187, 590
Hay ... do....	3, 794		Ties, railroad .. number.	4, 5 0	
Iron ... pounds..		458, 590	Wheat ... bushels .	41, 843	114, 293
Iron, pig ... tons..		40	Wood ... cords		100
Leather ... do ...	10	61	Wool ... pounds..	30, 240	
Live-stock ... number..		5, 200			

IMPORTS.

Coal ... tons..	9, 405		Merchandise, general, packages ..	29, 231	
Dry goods ... packages..	5, 396		Oil ... barrels	796	
Fish ... pounds..	932, 800		Plaster, land ... tons..	764	
Fruits ... packages..	2, 000		Salt ... pounds..	2, 292, 00	
Groceries ... do ...	24, 831		Shingles ... number .	8, 943, 000	
Hardware ... tons..	250		Slabs ... cords..	2, 175	
Hides ... number..	1, 064		Stone ... do....	968	
Laths ... do ..	491, 000		Wood ... do ...	820	
Lumber ... feet, B. M..	5, 857, 000				

In addition to the above there were exported and imported by the Milwaukee, Lake Shore and Western Railway 11,558,990 pounds, and by the American Express Company 318,240 pounds.

H H 16.

IMPROVEMENT OF SHEBOYGAN HARBOR, WISCONSIN.

Estimated cost (see Report of Chief of Engineers, 1881, page 2104)	$150,000
Additional estimate (Annual Report of Chief of Engineers, 1884, page 1856)	35,000
	195,000
Appropriated	83,000

The existing project of improvement at this harbor consists in the extension to the 20-foot curve in Lake Michigan of two piers, built under the projects of 1852 and 1873, and in dredging so as to afford a channel of 18-feet depth.

During the last fiscal year a contract was entered into with Truman & Cooper, of Manitowoc, Wis., for building and sinking on a pile foundation, seven cribs, each 50 feet long by 20 feet wide, and covering them with superstructure. At the close of the year a small part of the piles had been driven and four cribs were well under way.

The agreement of C. H. Harms, for dredging 7,000 cubic yards of material from the channel, was completed early in July, 1884, by the removal of 619 cubic yards.

By hired labor 300 linear feet of the north pier was riprapped, cribs Nos. 25 and 26 of the same pier were partly filled and planked, and some minor repairs were made to the decking of both piers.

During the same period the United States dredges No. 1 and No. 2 removed from the channel 35,263 cubic yards of material, affording a channel between the piers with from 15 to 17 feet depth of water.

The north pier is now 1,844 feet long and the south pier is 1,910 feet long. When the existing contract is completed they will be 1,844 and 2,260 feet in length, respectively, terminating in water about 13½ feet deep, and the south pier will extend about 100 feet further into the lake than the north pier. An examination of the harbor was made in June, but is not yet platted.

The condition of the shore end of the south pier is such as to require repairs very soon. For 150 feet outside the present shore line and for about the same distance inside it, the superstructure is badly rotted and burned away, and sand is driven through into the channel to such an extent that the shore line just south of the south pier which, in the forty years preceding 1879, had advanced over 300 feet, since that time has slightly receded. There is some doubt as to the responsibility for the care of this part of the work. It was occupied for several years by the Sheboygan and Fond du Lac Railroad Company as a wharf front; their warehouse and dock burned down a few years ago and has not been rebuilt; it is probable that the needed repairs must be made by the United States, if they are made at all.

With the appropriation asked for the fiscal year ending June 30, 1887, it is proposed to continue the work of pier extension and dredging; also to make some repairs to the piers.

Money statement.

July 1, 1884, amount available	$344 04
Amount appropriated by act approved July 5, 1884	28,000 00
	28,344 04
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,070 11
July 1, 1885, amount available	21,273 93

Amount (estimated) required for completion of existing project........	$112,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	60,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for pier extension at Sheboygan Harbor, Wisconsin, opened at engineer office Milwaukee, Wis., at 10 o'clock a. m., Tuesday, August 26, 1884.

No.	Names and addresses of bidders.	Pine timber, 12 by 18 and 12 by 12 inches, 13,500 linear feet, per linear foot.	Hemlock timber, 12 by 18 and 12 by 12 inches, 11,000 linear feet, per linear foot.	Pine plank 15,000 feet B. M., per M feet B. M.	Stone 775, cords, per cord.	Drift bolts, 20,000 pounds, per pound.	Screw bolts, 4,000 pounds, per pound.	Spikes, 550 pounds, per pound.	Piles, 100, per pile.	Total approximate value of bid.
1	Hanson & Scove, Manitowoc, Wis	$0 35	$0 32	$18 00	$9 00	$0 04	$0 05	$0 05	$19 00	$18,417 50
2	Christopher H. Starke, Milwaukee, Wis	*30	....	25 00	8 00	03	06	05	12 00	15,992 50
3	Truman & Cooper, Manitowoc, Wis	25	22	15 00	7 00	03	05	04	10 00	13,267 00
4	Christian Schwarz and Charles Berner, Green Bay, Wis	26	24	20 00	8 00	03½	04	04	10 00	14,532 00
5	Knapp & Gillen, Racine, Wis	32	32	20 00	8 75	03½	05½	05½	16 00	17,471 50

* 24,500 feet. No bid for hemlock timber.

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from H. G. H. Reed, general superintendent Milwaukee, Lake Shore and Western Railway, and E. P. Ewer, agent Goodrich Transportation Company.]

Name of harbor, Sheboygan, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Sheboygan, Wisconsin.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers	677	492,794	13,696	677	492,794	13,696
Sailing-vessels	560	47,785	2,491	567	49,780	2,504
Total	1,237	540,579	16,187	1,244	542,574	16,200

EXPORTS BY WATER.

Articles.		Amount.	Articles.		Amount.
Apples	barrels	500	Leather	tons	80
Beans	bushels	575	Lime	barrels	50,000
Brick	number	2,000,000	Live-stock	number	200
Butter	pounds	55,000	Machinery	pounds	75,000
Calves (dressed)	do	310,000	Merchandise, general	do	10,000
Castings	do	30,000	Oats	bushels	45,000
Chairs	number	1,000,000	Peas	do	2,000
Chair-seats (perforated)	do	1,800,000	Pork-barrels	number	7,500
Cheese	pounds	250,000	Potatoes	barrels	1,000
Eggs	dozen	165,000	Rags	pounds	100,000
Fish	packages	1,000	Stone	cords	500
Flour	barrels	3,000	Tallow	pounds	1,000
Furniture	pieces	100,000	Tools, farm	tons	40
Hay	tons	900	Wheat	bushels	100,000
Hollow-ware	do	600	Wooden-ware	dozen	2,700

Arrival and departure of vessels—Continued.

IMPORTS BY WATER.

Articles.	Amount.	Articles.	Amount.
Apples .... barrels..	5,200	Leather .... tons..	40
Bark .... cords..	6,200	Lumber .... feet, B. M. ..	39,000,000
Brick, fire .... number..	20,000	Machinery .... pounds..	200,000
Coal .... tons..	25,000	Merchandise, general .... do ...	100,000
Corn .... bushels..	3,000	Oil .... barrels..	2,000
Dry goods .... tons..	600	Plaster, land .... tons..	5,000
Feed .... do ...	300	Provisions .... pounds..	10,000
Flour .... barrels..	1,000	Salt .... do....	25,000
Fruit .... pounds..	200,000	Shingles .... number..	16,000,000
Groceries .... tons..	1,000	Stone .... cords..	1,000
Hardware .... do....	750	Varnish .... barrels..	3,200
Hides .... number..	7,800	Whisky .... barrels..	2,000
Iron and steel .... pounds..	1,700,000	Wood .... cords..	4,500
Laths .... feet, B. M..	2,200,000		

In addition to the above the Milwaukee, Lake Shore and Western Railway transported the following:

Exports .... pounds..	59,900,000
Imports .... do....	44,898,000

H H 17.

IMPROVEMENT OF PORT WASHINGTON HARBOR, WISCONSIN.

Estimated cost (see Report of Chief of Engineers, 1877, page 866)..........	$154,527 17
Additional estimate (Report of Chief of Engineers, 1880, page 1922)......	27,000 00
	181,527 17
Appropriated........................	164 500 00

The project for the improvement of this harbor consists in the construction of two parallel piers, about 150 feet apart, extending from the shore line to the 14-foot curve in Lake Michigan; and in the formation of two interior basins, having an aggregate area of about 5¾ acres and a depth of 12 feet of water, connected with deep water of Lake Michigan by a 12-foot channel.

During the past fiscal year, under a contract with Truman & Cooper, of Manitowoc, Wis., 350 linear feet of superstructure over the north pier and 250 linear feet over the south pier was completed.

By hired labor and the use of two United States dredges 16,513 cubic yards of material were dredged from the channel during the month of June.

The length of the north pier is 870 feet and of the south pier 1,226 feet. The channel, for a width varying from 35 to 110 feet, has the required depth of 12 feet or more.

With the money asked for the fiscal year ending June 30, 1887, it is proposed to complete the project by pier construction and dredging.

Money statement.

July 1, 1884, amount available........................	$60 50
Amount appropriated by act approved July 5, 1884........................	10,000 00
	10,060 50
July 1, 1885, amount expended during fiscal year, exclusive of oustanding liabilities July 1, 1884........................	7,679 11
July 1, 1885, amount available........................	2,381 39

Amount (estimated) required for completion of existing project	$17,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	17,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for pier extension at Port Washington Harbor, Wisconsin, opened at engineer office, Milwaukee, Wis., at 10 o'clock a. m., Tuesday, August 26, 1884.

No.	Names and addresses of bidders.	Pine timber, 12 by 12 inches, 9,660 linear feet, per linear foot.	Pine plank, 25,000 feet, B. M., per foot.	Stone, 300 cords, per cord.	Drift-bolts, 10,000 pounds, per pound.	Screw bolts, 200 pounds, per pound.	Spikes, 1,500 pounds, per pound.	Relaying 7,000 feet, B. M., pine plank, per foot.	Total approximate value of bid.
1	Hanson & Scove, Manitowoc, Wis	$0 32	$17 00	$7 00	$0 04	$0 06	$0 05	$4 00	$6,131 20
2	Christopher H. Starke, Milwaukee, Wis	34	27 00	7 50	03½	06	05	15 00	6,751 40
3	Truman & Cooper, Manitowoc, Wis	20	15 00	5 85	03	05	04	2 50	4,449 50
4	Christian Schwarz and Charles Berner, Green Bay, Wis	24	15 00	6 25	03½	04	04½	6 00	5,035 90
5	Knapp & Gillen, Racine, Wis	30	18 00	6 75	03½	05	05	12 00	5,892 00

List of materials and labor used at Port Washington Harbor in building 600 linear feet of superstructure two courses high and filling and planking same, and in building 150 linear feet of superstructure six courses high and filling and planking.

[Under contract with Truman & Cooper, dated September 20, 1884.]

		600 linear feet, two courses.	150 linear feet, six courses.	Price.	Cost.
Pine timber, 12 by 12 inches	linear feet	5,905	4,557	$0 20	$2,092 40
Pine plank relaid	feet B. M	2,817	705	2 50	8 81
Pine plank, new	do	26,871	6,717	15 00	503 82
Stone	cords	240	151.4	5 85	2,289 69
Drift-bolts	pounds	6,972	4,665	03	349 11
Screw-bolts	do		192	05	9 60
Spikes	do	1,113	276	04	55 56
Total cost		$3,248 79	$2,060 20		5,308 99

Cost per linear foot of superstructure:

Two courses high, filled and planked	$5 41
Six courses high, filled and planked	13 73

COMMERCIAL STATISTICS FOR THE YEAR ENDING DECEMBER 31, 1884.

[Obtained from Mr. Richard C. Kann.]

Name of harbor, Port Washington, Wisconsin.
Collection district, Milwaukee, Wisconsin.
Nearest light-house, Port Washington, Wis.

Arrival and departure of vessels.

	Arrivals.			Departures.		
	Number.	Tonnage.	Crews.	Number.	Tonnage.	Crews.
Steamers	28			28		
Sailing-vessels	182		542	181		
Total	210		542	209		

Arrival and departure of vessels—Continued.

EXPORTS.

Articles.	By water.	By rail.	Articles.	By water.	By rail.
Beans .... bushels..	....	600	Lives tock .... number..	....	1,600
Beer .... barrels..	....	1,240	Malt .... bushels..	....	160,000
Butter .... tons..	11	19	Merchandise, general tons..	....	210
Castings .... do....	....	800	Oats .... bushels..	18,000	....
Cheese .... do ...	....	420	Peas .... do ...	....	21,000
Eggs .... barrels..	....	1,600	Potatoes .... barrels..	....	43,000
Fish .... packages..	....	280	Rye .... bushels..	....	8,100
Flour .... barrels..	....	6,000	Tallow .... pounds..	....	22,000
Hides .... number..	....	280	Wheat .... bushels..	16,000	80,000
Leather .... tons..	....	310	Wool .... tons..	....	41
Lime .... barrels..	....	800,000			

IMPORTS.

Apples .... barrels..	....	160	Leather .... tons..	....	4
Bark .... cords..	700	....	Lumber .... feet, B. M..	....	6,200 000
Barley .... bushels..	....	42,000	Machinery .... pounds..	....	44,000
Coal .... tons..	....	900	Merchandise, general .tons..	....	68
Corn .... bushels..	....	2,200	Oil .... barrels..	....	620
Dry goods .... tons..	....	11	Plaster, land .... tons..	....	180
Groceries .... do....	....	310	Provisions .... do....	....	41
Hardware .... do....	....	670	Salt .... barrels..	....	890
Hides .... number..	....	42,100	Shingles .... number..	....	6,000,000
Iron and steel .... pounds..	....	1,600,000	Wood .... cords..	....	110
Laths .... number..	....	1,000,000			

H H 18.

PRELIMINARY EXAMINATION OF LAC LA BELLE HARBOR, MICHIGAN.

ENGINEER OFFICE, U. S. ARMY,
Milwaukee, Wis., October 20, 1884.

GENERAL: In compliance with the requirements of the river and harbor act of July 5, 1884, and the instructions contained in your letter of September 4, 1884, I have the honor to present the following report of a preliminary examination of Lac la Belle Harbor, Michigan.

The act requires the local engineer to report whether in his opinion the harbor is worthy of improvement. To obtain the necessary facts I communicated by letter with several persons interested in Lake Superior navigation and made a personal visit to the harbor.

From Mr. Henry C. Davis, president of the Conglomerate Mining Company, whose works are located on the shore of the lake, much information was obtained.

Letters were also received from the Lake Superior Transit Company, the Lake Michigan and Lake Superior Transportation Company, and the Lake Superior Ship-Canal, Railway and Iron Company.

Copies of these several communications,* including a printed copy of a petition † to Congress to make Lac la Belle a permanent harbor of refuge, and a map † showing the piers at the entrance to the harbor, are transmitted herewith.

Lac la Belle is a small lake 30 feet deep, about 2 miles long by half a mile wide, lying three-quarters of a mile west of Bete Grise Bay; the latter being an indentation of the coast on Lake Superior, just south of

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* Omitted; printed in House Ex. Doc. No. 89, Forty-eighth Congress, second session.

† Omitted.

Keweenaw Point. This point extends 12 miles to the eastward; the bay is therefore well sheltered from northerly as well as westerly storms. For this reason, and also that it lies near the track of vessels passing around Keweenaw Point, it is much sought as a harbor of refuge in all heavy weather, except storms from the east to the south. Storms from these quarters would render this anchorage very insecure, unless provided with other protection than that afforded by nature. Under such circumstances the shelter of Lac la Belle would be of the greatest service.

A canal, with protecting piers at its outer entrance, was constructed from the bay to Lac la Belle about twenty years ago. This work was done by a company under a land grant from the United States, the proceeds of which, it is believed, were sufficient for the purpose. It is understood that it was the intention of the originators of the canal project to make Lac la Belle a port for the adjacent mineral region, and to connect it by rail with several of the mines north of Portage Lake. This scheme was not entirely successful, and a large part of the product of the mines has found other outlets.

The Conglomerate Mining Campany has, within the past few years, acquired control of the harbor and canal. It has made some repairs to the piers and dredged out the channel where obstructed. This company has built a substantial railway connecting their mines, 6 miles distant, with the harbor, and have put up a large stamp mill on the shore of the lake. It is quite probable that other mines, especially the Central, which now hauls its copper product to Eagle Harbor, will transfer its shipments to Lac la Belle, and that the present railway will be extended inland to connect with the Central mine. The harbor, therefore, may become of considerable local importance.

In its present condition the canal is upwards of 100 feet wide at the surface of the water, and is protected at the outer entrance by two parallel piers, which, considering their original cheap construction, are remarkably well preserved. This is owing to their sheltered location; otherwise, the storms of Lake Superior would have long ago destroyed them. The piers are respectively 636 and 603 feet in length, and terminate in 15 feet depth of water. They are 115 feet apart at the outer ends and for a length of 200 feet, beyond which the distance between them is 138 feet. This harbor would now seem to be capable of affording a refuge for nearly all classes of vessels that would be likely to seek its shelter. It might, however, be advisable to increase the depth of water in the canal, to admit vessels of 14 or perhaps 16 feet draught. This can readily be done by dredging, as the material to be removed is sand. In that case the piers should be extended to 18 or 20 feet depth of water. They would need some immediate repairs, and a periodica renewal of the superstructure.

A careful consideration of all the facts bearing upon this question leads me to the opinion that an improvement to the extent of repairing and maintaining the entrance of Lac la Belle is worthy to be made for the purpose of affording a harbor of refuge within its borders; and that, to make it available for this purpose, suitable lights should be established by the Government. To ascertain the cost of the necessary repairs upon the piers, and the required dredging in the canal, an allotment of $500 for a survey will be necessary.

Respectfully submitted,

J. W. Barlow,
Lieut. Col. of Engineers.

Brig. Gen. John Newton,
Chief of Engineers, U. S. A.

PROJECT FOR IMPROVEMENT OF LAC LA BELLE HARBOR, MICHIGAN.

ENGINEER OFFICE, U. S. ARMY,
Milwaukee, Wis., January 1, 1885.

GENERAL: In compliance with instructions contained in your letter of November 21, I have the honor to submit the following report and estimates upon a project for the improvement of Lac la Belle Harbor, Michigan, an examination or survey of which was provided for in the river and harbor act of July 5, 1884.

The principal object to be attained by the improvement of this harbor is to afford a refuge in stormy weather to vessels engaged in trade to and from Lake Superior ports.

Owing to the exposed and isolated position of Lac la Belle and its high latitude, 47° north, with the stormy weather and accumulation of snow and ice during the late fall and winter months, it has been impracticable to make a satisfactory survey since authority to do so was received, nor can any survey be made before spring without entailing great expense.

The information contained in my report upon a preliminary examination of this harbor, dated October 20, 1884, a copy of which is appended hereto, together with further data obtained since that report was submitted, enable me to present estimates of the cost of the improvements required to make Lac la Belle accessible as a harbor of refuge.

As stated in my report of October 20, "Lac la Belle is a small lake, 30 feet deep, about 2 miles long by half a mile wide, lying three-quarters of a mile west of Bete Grise Bay, the latter being an indentation of the coast on Lake Superior just south of Keweenaw Point."

A canal about three-quarters of a mile long connects the water of Lac la Belle with that of Bete Grise Bay; from the outer entrance of the canal two piers extend into the bay 636 feet and 603 feet long, respectively. The distance between these piers is 138 feet for a length of about 400 feet from the inner ends; beyond this they are 115 feet apart.

These improvements were made about twenty years ago by a private corporation, the Lac la Belle Harbor Improvement Company. After the improvements were begun Congress, by act approved July 3, 1866, granted 100,000 acres of land to the State of Michigan for the use and benefit of the company, fixing the dimensions of the canal connecting Lac la Belle with Bete Grise Bay, which was to be built by the company. These dimensions, 100 feet wide at top, 75 feet wide at bottom, and at least 12 feet in depth for its entire lenth, extending from 16 feet depth of water in Bete Grise Bay to 14 feet in Lac la Belle, are practically the dimensions at the present time.

In order to obtain the views of parties well informed as to the need of a harbor of refuge at Lac la Belle, I corresponded with the Lake Superior Transit Company, the Lake Michigan and Lake Superior Transportation Company, the Conglomerate Mining Company, and the Lake Superior Ship-Canal, Railway and Iron Company.

The officers of the first three companies named were unanimous in the opinion that the improvement would be of much benefit to commerce; the superintendent of the Lake Superior Ship-Canal, Railway and Iron Company did not consider it a greatly felt want, and stated that Copper Harbor, which is on the north side of Keweenaw Point, 28 miles distant from Lac la Belle, is at all times accessible. This opinion is at variance with the opinions expressed by the officers of the Conglomerate Mining Company and the Lake Michigan and Lake Superior Transportation Company, the former stating that Copper Harbor is not accessible in heavy weather, and the latter giving as one reason why a harbor of refuge should be established at Lac la Belle that Copper Harbor is dangerous for vessels to enter in foggy and snowy weather, as, in order to do so, they have to pass near dangerous rocks and reefs.

Copies of the letters referred to are given with my report of October 20, appended hereto.

In making such improvements as the present wants of commerce seem to require, the work already done by the Lac la Belle Harbor Improvement Company can be utilized and a permanent harbor provided at a present moderate outlay, and future small annual appropriations for its maintenance.

The recommendations contained in my preliminary report were made with this view, and contemplated providing an entrance to Lac la Belle of dimensions sufficient to accommodate the local business of the harbor, and also to admit for refuge such vessels as would be likely to require its shelter. It was then and is still believed that the larger class of vessels which anchor in Bete Grise Bay in stress of northerly or westerly weather leave that anchorage to pursue their course on a change of wind, and that only vessels of moderate draught would be compelled to pass through the canal for security.

In accordance with these views I have prepared and submit the following project for the repair and maintenance of the present piers and canal, without providing any material enlargement of the channel. It provides for the repair of the piers by constructing 800 linear feet of sheet-pile revetment on the inner sides of the piers, and extending this revetment from the inner ends of the piers along both sides of the canal a distance of about 400 feet for the purpose of keeping the channel clear of sand, which, in the present condition of the piers, is constantly sifting into it, and also for dredging a channel 15 feet deep between the piers and 12 to 14 feet deep through the canal.

The estimate for this project is as follows:

PILE REVETMENT, 1,600 FEET LONG.

Piles, 400 = 10,688 linear feet, at 15 cents per linear foot	$1,603 20
Pine timber, round, 12 inches in diameter, 1,728 linear feet, at 10 cents per linear foot	172 80
Pine timber, 12 by 12 inches, 7,840 linear feet, at 30 cents per linear foot	2,352 00
Pine plank, 3 by 12 inches, 240,768 feet, B. M., at $30 per thousand	7,223 05
Iron, 28,979 pounds, at 5 cents per pound	1,448 95
Total	12,800 00

DEEPENING CHANNEL.

Dredging 11,000 cubic yards from harbor, at 30 cents per cubic yard	$3,300 00
Dredging 26,000 cubic yards from canal, at 25 cents per cubic yard	6,500 00
Total	9,800 00

SUMMARY.

Pile revetment, 1,600 feet in length	$12,800 00
Dredging	9,800 00
	22,600 00
Superintendence and contingencies	2,400 00
Total	25,000 00

No estimate is included in the above for the purchase of existing works, as it is to be presumed that the title thereto will be granted free of cost should the United States undertake to provide for the maintenance of the harbor.

Should Congress, however, require the construction of a harbor of refuge at this place which shall admit all classes of vessels plying on Lake Superior under all conditions of weather, it would be necessary to widen the entrance to 200 feet, extend the piers to the 20-foot curve, and dredge the channel to a depth of 18 feet. The cost of such a project, as shown by the following estimate, would be $114,000.

ESTIMATE OF MATERIAL AND COST OF BUILDING 1,050 LINEAR FEET OF CRIB PIER, 1,360 LINEAR FEET OF PILE REVETMENT, AND DREDGING 68,400 CUBIC YARDS OF MATERIAL.

Twelve cribs, each 50 by 24 feet, by 20 to 24 feet in height, including superstructure.

Timber, 12 by 12 inches, 74,400 linear feet at 30 cents per linear foot	$22,320
Plank, 3 by 12 inches, 43,200 feet, B. M., at $20 per thousand	864
Iron, 72,000 pounds, at 5 cents per pound	3,600
Stone, 2,652 cords, at $8 per cord	21,216
Total	48,000

Nine cribs, each 50 by 20 feet, by 16 to 20 feet in height, including superstructure.

Timber, 12 by 12 inches, 42,090 linear feet, at 30 cents per linear foot	$12,627
Plank, 3 by 12 inches, 23,400 feet, B. M., at $20 per thousand	468
Iron, 40,500 pounds, at 5 cents per pound	2,025
Stone, 1,260 cords, at $8 per cord	10,080
Total	25,200

Pile revetment.

1,360 linear feet, at $8 per foot	10,880

Dredging.

42,400 cubic yards from harbor, at 30 cents per cubic yard	$12,720
26,000 cubic yards from canal, at 25 cents per cubic yard	6,500
	19,220

SUMMARY.

Crib pier, 1,050 feet long	$73,200
Pile revetment, 1,360 feet long	10,880
Dredging	19,220
	103,300
Superintendence and contingencies	10,700
Total	114,000

The cost of removing the old pier has not been considered in the above estimate, as the value of the material therein would about offset the labor of its removal.

In this, as in the preceding estimate, it is assumed that the canal and piers will be transferred to the United States without cost.

Lac la Belle is in the collection district of Superior, Michigan.
There is a light house on Gull Rock, 15 miles distant.

LIST OF ACCOMPANYING PAPERS.

1. Plan of piers.*
2. Plan of pile revetment.*
3. Copy of report on preliminary examination, containing—
4. Copy of letter from Conglomerate Mining Company, dated August 9, 1884.

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*Omitted.

5. Copy of letter from Lake Superior Transit Company, dated August 23, 1884.
6. Copy of letter from Lake Michigan and Lake Superior Transportation Company, dated August 22, 1884.
7. Copy of letter from Lake Superior Ship-Canal Company, dated August 26, 1884.
8. Plan of piers at Lac la Belle.*
9. Printed petition to Congress.*

Respectfully submitted.

J. W. BARLOW,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

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H H 19.

PRELIMINARY EXAMINATION OF ASHLAND HARBOR, WISCONSIN.

ENGINEER OFFICE, U. S. ARMY,
Milwaukee, Wis., October 21, 1884.

GENERAL: In compliance with the requirements of the river and harbor act of July 5, 1884, and the instructions contained in your letter of September 4, 1884, I have the honor to present the following report of a preliminary examination at Ashland Harbor, Wisconsin, made, as required by the act, for the purpose of ascertaining if this harbor is worthy of improvement by the United States.

A similar examination was made under the river and harbor act of 1879, on which occasion the officer did not report in favor of an improvement.

Since the date of that report Ashland has changed materially. At that time there was hardly any business, no commerce, and the village was but a straggling hamlet of a few houses.

The accompanying report of the Business Men's Association of Ashland,† the facts of which were verified by me at a recent visit to the place, shows that Ashland now has a population of over 4,000 people, and a large and rapidly increasing business. This is in a great measure due to the development of the iron and lumber resources of the adjoining country.

Following is a brief statement of the several industries now carried on at this place:

Five saw-mills, cutting annually 55,000,000 feet of lumber, the product valued at	$550,000
One sash, door, and blind factory, doing an annual business of	35,000
One planing, with capacity per day of 100,000 feet.	
Four hardware stores, doing an annual business of	170,000
Seven dry goods and general-merchandise stores, annual business	280,000
Five clothing stores, annual business	125,000
Thirteen grocery and supply stores, annual business	130,000
Four drug stores, annual business	45,000
Two flour and feed stores, annual business	100,000
Fifteen miscellaneous stores.	
Fifteen hotels.	
Seven restaurants.	
Two banks.	
Two merchant-tailors.	
Two real estate offices.	
Four saw firms.	

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* Omitted.

† Omitted; printed in House Ex. Doc. No. 89, Forty-eighth Congress second session.

Among the exports are reported from 25,000,000 to 30,000,000 feet of lumber, and 4,200 tons of general merchandise, in transit to Lake Superior ports.

There are imported annually 4,500 tons of coal, besides salt, cement, hardware, and general merchandise.

Ashland has four different lines of railroad, viz:

(1) The Northern Pacific; this point being its probable eastern terminus.

(2) The Wisconsin Central; two lines.

(3) The Chicago, Saint Paul, Minneapolis and Omaha.

(4) The Milwaukee, Lake Shore and Western.

The latter is not yet completed, but soon will be, and has contracted for the construction of extensive ore docks at this place.

These facts, I think, are sufficient, from a business and commercial point of view, to justify the Government in providing a reasonable and necessary protection for the commerce of the harbor.

Chequamegon Bay, on the east shore of which the town is located, being separated from Lake Superior by Chequamegon Point, would seem to require but little artificial aid to render it, under all conditions of weather, a thoroughly protected harbor. The length of the bay northeast and southwest is 12 miles, and its average width is 5 miles.

It is stated by the residents of the place that a troublesome sea in northeast storms seriously interferes with the security of vessels while lying at the wharves. This sea probably originates within the bay, but may be somewhat augmented by the swell which passes around the point from Lake Superior. The construction of a jetty northeast of the town, extending from the shore 4,000 feet or more into the bay, is desired by those interested as a means of preventing this disturbance.

In my opinion such a jetty would have a beneficial effect; and as it would never be subject to very severe wave action, the cheap method of construction suggested by the citizens should answer the purpose.

The opening through Chequamegon Point has at present but little effect upon the wave disturbance in the bay; but a considerable enlargement, however, might result in a current which would carry material in the direction of Ashland, and possibly reduce the depth of water in the vicinity of the wharves. When this contingency becomes imminent, means of protection should be adopted.

It is stated that a break through this point has occurred and refilled by natural causes, on several different occasions, within the remembrance of persons living in the neighborhood, and that at no time has the opening reached serious proportions. Another source of annoyance to the shipping interests is a long, narrow shoal, having over it about 11 feet depth of water, and extending in a direction parallel to the shore. It lies about opposite the middle of the town, and is in the track of vessels approaching the principal wharves. Whether this shoal was there originally or has formed within a recent period is uncertain, as statements on this point are conflicting.

A map* showing the present limits of Ashland and its wharfage is sent herewith.

A chart* of Chequamegon Bay is also sent, which gives the location of Ashland and two positions suggested for a breakwater. The blue line indicates the location desired by the citizens. That shown in the red would, in my opinion, afford the most protection, with an equal length of structure.

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*Omitted.

From the foregoing facts I have respectfully to state that, in my judgment, the harbor of Ashland is worthy of improvement, and that to ascertain the exact nature and cost of the improvements required a survey should be made. For this purpose an allotment of $400 is necessary.

Respectfully submitted.

J. W. BARLOW,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

PROJECT FOR IMPROVEMENT OF ASHLAND HARBOR, WISCONSIN.

ENGINEER OFFICE, U. S. ARMY,
Milwaukee, Wis., January 1, 1885.

GENERAL: In compliance with instructions contained in your letter of November 21, I have the honor to submit the following report upon a project for the improvement of Ashland Harbor, in Ashland Bay, Lake Superior, Wisconsin, an examination or survey of which was provided for in the river and harbor act of July 5, 1884.

As required by the act a preliminary examination was made and a report thereon submitted, dated October 21, 1884, a copy of which is transmitted herewith, as it contains nearly all the information relating to the harbor that I have been able to obtain.

Since the receipt of authority to make a more thorough survey than was possible at the first examination, the weather has prevented, and will continue to prevent until spring, the necessary hydrographic operations to give satisfactory results within any reasonable expense. And as sufficient facts are now on hand for the purpose, I have made, and present herewith, approximate estimates of the cost of the desired improvements:

These improvements are (1) a breakwater to be located northeast of the wharfage, extending at right angles to the shore, and designed to protect the wharves of the city from the action of north and northeast storms; (2) the removal of a shoal lying in front of the principal wharves, and which now obstructs free access to them.

The proposed breakwater can never be subjected to very severe wave action, as the heavy seas from Lake Superior are arrested by Chequamegon Point, only about 8 miles distant. The disturbance against which protection is desired is caused by north to northeast winds, which create, inside the bay, a short, chopping sea, at times seriously interfering with the use of the wharves by vessels.

A structure, therefore, of moderate width and cheap construction, will have sufficient stability and durability; and if extended out about 8,000 feet will serve the purposes for which it is desired.

The exact location of the breakwater should be determined after a further examination of the bottom has been made, for the purpose of ascertaining the nature of the material to be penetrated by the piles, and also the most desirable line for protecting the present and prospective wharfage.

But as the approximate location of the desired breakwater has been determined and no special difficulties in the method of construction are anticipated, there seems to be no necessity for delaying action upon the project until the surveys recommended as preliminary to beginning the work have been made, the results of which, in this case, have no bearing upon the expediency of providing for the improvement of the harbor.

The design of the proposed breakwater presented herewith, and which is believed to be amply strong, consists of two parallel rows of piles, driven 3 feet from center to center, strengthened by wales and cross-ties at the water-surface, and finished at the top with two courses of 12 by 12 feet timber on each row, also connected by timber cross-ties.

The width of the breakwater will be at first, 12 feet; increasing as more depth is attained to 14 feet, 16 feet, 18 feet, and 20 feet, and its total length will be 7,900 feet.

The filling will be of the cheapest material attainable; brush and logs; or slabs and edgings from the saw-mills, except a top covering about 2 feet in thickness, which will be of stone.

A plank walk 2 feet wide will extend the entire length.

The first section of 1,700 linear feet, 12 feet wide, will cost $8.70 per linear foot	$14,790
The second section, of 1,400 linear feet, 14 feet wide, will cost $11.93 per linear foot	16,702
The third section of 1,500 linear feet, 16 feet wide, will cost $14.58 per linear foot	21,870
The fourth section of 1,500 linear feet, 18 feet wide, will cost $16.82 per linear foot	25,230
The fifth section of 1,800 linear feet, 20 feet wide, will cost $19.65 per linear foot	35,370
	113,962
Superintendence and contingencies	11,038
Total	125,000

ESTIMATE OF MATERIALS, AND COST OF BUILDING 7,900 LINEAR FEET OF BREAKWATER AS ABOVE DESIGNED.

Timber, 12 by 12 inches = 56,830 linear feet, at 30 cents per foot	$17,049 00
Timber, 8 by 12 inches = 34,326 linear feet, at 20 cents per foot	6,865 20
Plank, 3 by 12 inches = 58,300 feet, B. M., at $20 per M	1,166 00
Piles, 6,058 = 160,944 linear feet, at 15 cents per foot	24,141 60
Iron, 148,484 pounds, at 5 cents per pound	7,424 20
Filling, brush, slabs, &c., 14,500 cords, at $3 per cord	43,500 00
Filling, stone, 1,727 cords, at $8 per cord	13,816 00
	113,962 00

REMOVAL OF SHOAL.

The quantity of material necessary to be removed from the 11-foot shoal in front of the city wharves, or to make a channel through it of sufficient depth and width to meet the present demands of commerce, would not probably exceed 40,000 cubic yards.

The cost of this dredging would be as follows:

40,000 cubic yards, estimated, at 25 cents per cubic yard	$10,000
Superintendence and contingencies, 10 per cent	1,000
Total	11,000

SUMMARY.

Cost of breakwater, 7,900 feet in length	$113,962
Cost of removing 40,000 cubic yards of sand	10,000
Superintendence and contingencies	12,038
Total	136,000

Ashland is located on the south side of Chequamegon Bay, Lake Superior, about 60 miles east of Duluth, Minn.

It is in the collection district of Superior, Marquette, Mich., being the port of entry.

The nearest light-house is La Pointe, on Chequamegon Point, at the entrance to Chequamegon Bay.

LIST OF ACCOMPANYING PAPERS.

*1. Plan of breakwater.
2. Copy of report on preliminary examination containing—
*3. Map of Ashland.
*4. Map of Chequamegon Bay and vicinity.

Respectfully submitted.

J. W. BARLOW,
Lieut. Col. of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

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* Omitted.

APPENDIX I I.

CONSTRUCTION OF HARBOR OF REFUGE, MILWAUKEE BAY—IMPROVEMENT OF THE HARBORS OF MILWAUKEE, RACINE, KENOSHA, AND WAUKEGAN, LAKE MICHIGAN—IMPROVEMENT OF FOX AND WISCONSIN RIVERS.

REPORT OF CAPTAIN W. L. MARSHALL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Harbor of refuge, Milwaukee Bay, Wisconsin
2. Milwaukee Harbor, Wisconsin.
3. Racine Harbor, Wisconsin.
4. Kenosha Harbor, Wisconsin.
5. Waukegan Harbor, Illinois.
6. Fox and Wisconsin rivers.

UNITED STATES ENGINEER OFFICE,
Milwaukee, Wis., July 29, 1885.

SIR: I have the honor to transmit herewith annual reports for the works in my charge for fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

W. L. MARSHALL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

I I 1.

HARBOR OF REFUGE AT MILWAUKEE BAY, WISCONSIN.

CONDITION OF THE WORK JUNE 30, 1885.

At the close of the fiscal year ending June 30, 1884, the breakwater had been extended 2,450 feet, completing the north arm, except superstructure, 850 feet of which had been completed.

Under the river and harbor act approved July 5, 1884, proposals were solicited and received for continuing the work under formal contract, and opened at Milwaukee, Wis., August 29, 1884.

The following is the abstract of proposals received:

Timber crib breakwater on stone foundation.

Number of proposals.	Names and residences of bidders.	Pine timber, 872,496 feet, B. M. per M.	Pine plank, 3-inch, 36,288 feet, B. M., per M.	Iron drift bolts, 90,240 pounds, per pound.	Iron screw bolts, nuts, and washers, 2,284 pounds, per pound.	Iron spikes, 8-inch, 2,676 pounds, per pound.	Stone ballast, 5,200 cords, per cord.	Framing timber, 872,496 feet, B. M., per M.	Pine plank, 3-inch, laying of 36,288 feet, B. M., per M.	Taking up plank, 3-inch, per M.	Total cost of 600 feet of crib breakwater on stone foundation.
1	Horatio Trueman, George Cooper, Manitowoc, Wis	$15 50	$15 50	$0 3	$0 4	$0 4	$7 90	$7 00	$1 50	$2 50	$64,223 64
2	Christopher H. Starke, Milwaukee, Wis	14 50	14 00	3	6	4	7 75	8 00	5 00	8 00	63,571 90
3	Knapp and Gillen, Racine, Wis	16 50	16 00	3½	6	5	8 00	6 00	6 00	9 00	65,238 11

With the approval of the Chief of Engineers the work of constructing 600 feet, more or less, of the breakwater and superstructure over the work previously executed was awarded to Christopher H. Starke, the lowest responsible bidder, who, under his contract dated September 12, 1884, during the fiscal year ending June 30, 1885, placed twelve cribs on stone foundation, extending the east arm of the breakwater 600 feet to the southward, and commenced the superstructure over 550 feet of breakwater previously constructed.

The length of the breakwater at the close of the fiscal year ending June 30, 1885, is 3,050 feet, over 850 linear feet of which the superstructure is completed and 550 feet partly built. There remains to be constructed of the breakwater 4,200 linear feet, including superstructure, and superstructure over 2,200 linear feet of substructure already placed.

The harbor now is beginning to be available to a very limited extent, as a harbor of refuge during northerly storms.

PROPOSED APPLICATION OF FUNDS AVAILABLE FOR EXPENDITURE DURING THE FISCAL YEAR ENDING JUNE 30, 1886.

There will be an additional crib sunk at the breakwater under Starke's contract, and superstructure over all work built prior to June 30, 1884, will be completed, and the unfinished structure will be lighted during the season of navigation, and maintained.

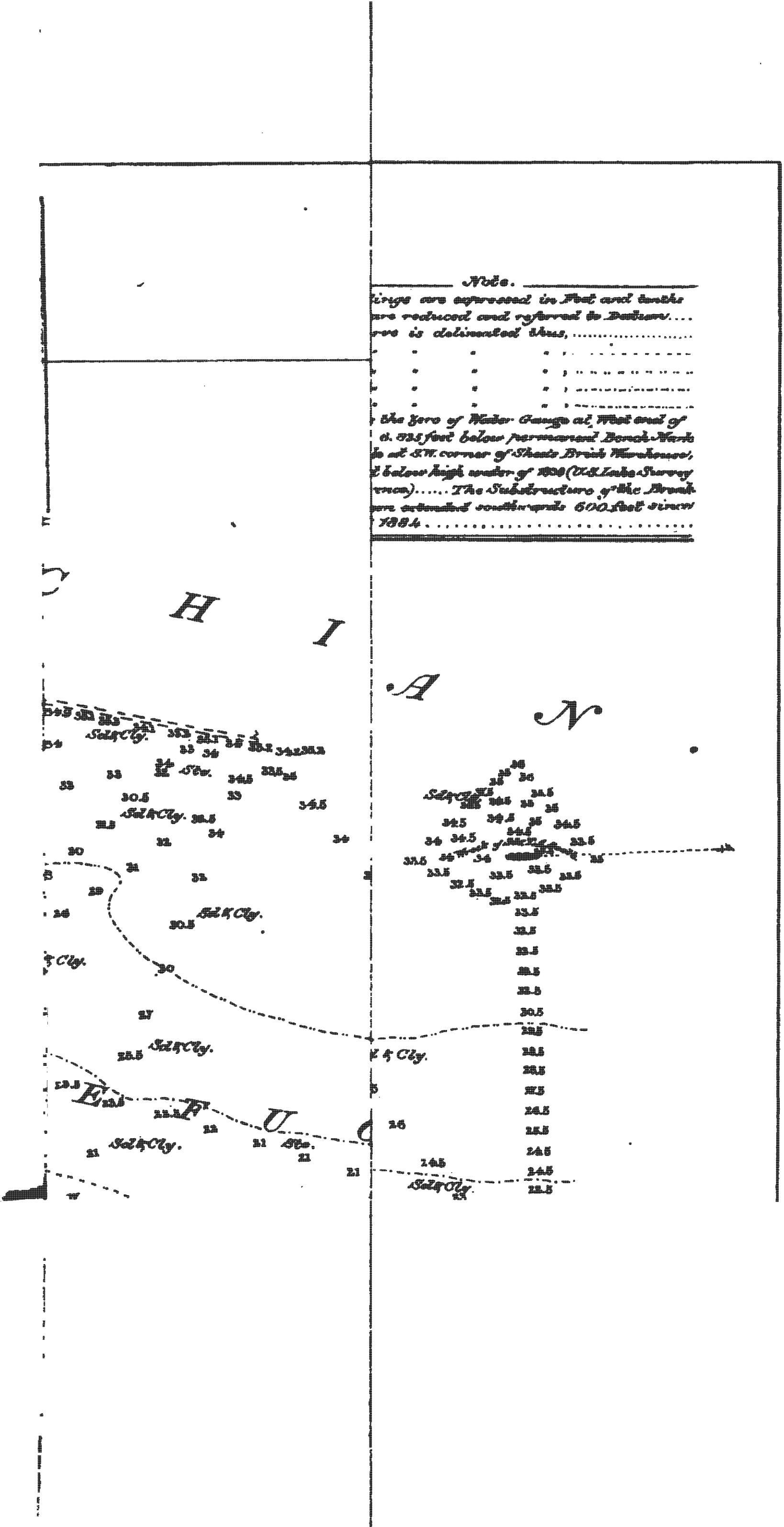
All funds available for work will be exhausted by September 1, 1885.

PROPOSED APPLICATION OF FUNDS ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

The funds asked for are to be used to extend the main arm of the breakwater southward, and to complete the superstructure over the work, as far at least as to the north entrance.

It is hoped that the next appropriation will be sufficient to advance the work sufficiently to be of use to a practical extent in northeast storms.

The nearest collection district is Milwaukee, Wis. The nearest port of entry is Milwaukee, Wis. Amount of revenue collected at the nearest port of entry during the last fiscal year, $193,553.30.



Note.

ings are expressed in Feet and tenths
are reduced and referred to Datum....
are is delineated thus, ...

the Zero of Water Gauge at West end of
0.525 feet below permanent Bench Mark
at S.W. corner of Sheats Brick Warehouse,
below high water of 1838 (U.S. Lake Survey
rom)..... The Substructure of the Break
are extended southwards 600 feet since
1884 ....

This harbor is of use to the general commerce of the lakes, including that between Lake Michigan ports and the ports of the other great lakes.

A statement of the amount of this commerce, which is increasing, may be found in Colonel Houston's report published in House Ex. Doc. No. 43, Forty-sixth Congress, third session.

The details of the work during the past fiscal year are given in the accompanying report of Assistant Engineer W. H. Hearding, who has been in local charge of the work since its inception.

Money statement.

July 1, 1884, amount available		$11,098 02
Amount appropriated by act approved July 5, 1884		85,000 00
		96,098 02
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$60,876 07	
July 1, 1885, outstanding liabilities	6,061 52	
		66,937 59
July 1, 1885, amount available		29,160 43
Amount (estimated) required for completion of existing project		515,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		250,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. W. H. HEARDING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Milwaukee, June 30, 1885.

SIR: I have the honor to present the following report in relation to the breakwater for harbor of refuge in Milwaukee Bay, Wisconsin.

An appropriation of $85,000 was made by Congress on the 5th of July, 1884, for continuing work upon the breakwater. Advertisements were inserted in the daily papers requesting proposals for constructing 600 running feet, more or less, of crib-work for the extension of breakwater and superstructure over cribs already in place. Christopher H. Starke, of Milwaukee, being the lowest bidder, was awarded the contract, which was entered into in due form on the 12th of September.

The first crib under this contract (No. 44) was sunk on the 10th day of October, and the sixth and last of the season (No. 49) was sunk in position on the 28th day of November. Soundings were taken on the 5th of December along the sides of these cribs and around the end of crib 49, which showed that more stone was required upon the east berm to bring the tops of foundations to the required height and width.

As soon as the deficiency had been supplied soundings were again taken, which showed the work to be in a safe condition to be left until the resumption of operations in 1885.

During the winter months the contractor was engaged in quarrying stone for crib ballast and foundations and in constructing cribs, five of which were nearly completed upon the opening of navigation. Crib No. 50 was sunk on the 4th of May last, and Crib 55 on the date of this report, the total length of breakwater now being 3,050 feet. The whole of the cribs under this contract are in excellent position and alignment, as are also all of the cribs forming the sections of breakwater which have been set upon stone foundations. This fact is of interest, inasmuch as the subject of "stone foundations" was discussed in 1872, and an article treating upon the subject was embodied in the Report of the Chief of Engineers for that year.

The favorable prices obtained under the contract admitted of the construction of one more crib, which has been built and is in readiness to sink. Superstructure has also been built to a height of 2¼ feet over Cribs Nos. 30 to 40, inclusive, and which will be raised to the height of 6 feet above datum. Superstructure will also be built to a height of 6 feet over cribs numbering from 1 to 15, which will complete the whole work upon the north arm 2,450 feet in length.

Stone will be placed upon the slopes of foundations wherever it may be needed to make them conform to the plan.

The area of anchorage protected by the breakwater and offering shelter from northeast storms is now becoming appreciable, and will be sought by vessels in stress of weather.

By observations carefully taken with a spirit level for the purpose of comparison with former levels, I find that no appreciable change has taken place in the heights of cribs, which were sunk in 1881, 1882, and 1883, since levels were taken last season. A considerable accretion of sand has formed on the shore of the northwest section of the bay.

On the 14th day of May, the schooner-rigged scow L. May Guthrie was engaged for service as a light-ship at the south end of the breakwater to be continued until the close of navigation, unless otherwise ordered.

I have the honor to subscribe myself, very respectfully, your obedient servant,

W. H. Hearding,
Assistant.

Capt. W. L. Marshall,
Corps of Engineers, U. S. A.

I I 2.

IMPROVEMENT OF MILWAUKEE HARBOR, WISCONSIN.

CONDITION OF THE WORK JUNE 30, 1885.

No work has been done during the year ending June 30, 1885, except repairing a slight damage by a collision of a vessel with the north pier. The project is completed, and the work practically in the same condition as on June 30, 1884.

The report of Assistant Engineer W. H. Hearding herewith, gives details of the work done and of the business of the port.

PROPOSED APPLICATION OF FUNDS NOW AVAILABLE AND THOSE ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to apply these funds to the rebuilding of superstructure over the north and south piers, outer sections, and to protect this work by guard piles, new fender piles, and bulkhead timbers at the end of the piers, the estimate for which is $27,532.72.

At important harbors like this, as the superstructure of piers need rebuilding, the work should be done, to lessen the cost of maintenance, of stone or concrete properly protected against damage by collision. Lumber will increase in the near future materially in value, and the cost of timber superstructures will more nearly approximate that of concrete each time they are renewed.

Money statement.

July 1, 1884, amount available	$11,245 82
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,554 93
July 1, 1885, amount available	9,690 89
Amount (estimated) required for completion of existing project	22,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	22,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. W. H. HEARDING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Milwaukee, June 30, 1885.

SIR: I have the honor to state that, with the exception of making repairs to the north pier, no work has been done at the entrance to Milwaukee Harbor during the past year.

The repairs made were the result of a collision of Steamer No. 1 of the Flint and Pere Marquette Railroad Company with the north pier, by which a section of the pile protection to the stone superstructure of the pier, about 75 feet in length, was considerably damaged.

The accident was unavoidable, and was due to the breaking of the steamer's rudder chains.

The accompanying plat of soundings, which were taken by me on the 15th ultimo, when compared with the soundings taken last year, shows that a slight diminution in the depth of water in the channel between the harbor piers has taken place; but the section of channel which carries a depth of 17 feet of water is as yet fully 100 feet in width.

The following extracts from the annual report of the secretary of the Board of Trade show some of the items of business transacted at Milwaukee:

Receipts: Beef cattle, 111,640; sheep, 92,828; hogs up to March 1, 563,212, of which 503,949 were packed; coal, 704,161 tons, of which 623,013 tons arrived by lake and 81,148 tons by rail; lumber, 230,162,000 feet, B. M.; shingles, 118,241,000; paper, 29,984,559 pounds; butter, 9,871,709 pounds; cheese, 24,491,954 pounds; tobacco, (Wisconsin), 7,210,004 pounds; wool, 4,449,387 pounds; wheat, 13,193,922 bushels; mill-stuffs, 44,441 tons; oil-cake, 27,748 sacks; flax-seed, 1,207,499 bushels; potatoes, 660,485 bushels; iron ore, 34,852 tons; flour, manufactured, 1,070,860 barrels; angle, bar, and plate iron, manufactured, 48,050 tons; pig iron, 28,000 tons; hydraulic cement, 216,000 barrels; nails, 163,000 kegs. Receipts of office of internal revenue, $2,426,146.34; post-office receipts, $244,941; bank deposits, $553,224,030.97.

The nearest collection district is Milwaukee, Wis. The nearest port of entry is Milwaukee, Wis.

The amount of revenue collected at this port during the fiscal year (customs) is reported by A. W. Hall, esq., collector, to have been $193,553.30.

He also gives the following information respecting the arrivals and departures of vessels from this harbor:

Arrivals and departures.	Number.	Tonnage.
Arrivals of steamers	2,514	1,933,576
Arrivals of sail vessels	2,505	483,809
Total	5,019	2,417,385
Departures of steamers	2,522	1,940,148
Departures of sail vessels	2,515	482,797
Total	5,037	2,422,945

Respectfully submitted.

W. H. HEARDING,
Assistant Engineer.

Capt. W. L. MARSHALL,
Corps of Engineers, U. S. A.

I I 3.

IMPROVEMENT OF RACINE HARBOR, WISCONSIN.

CONDITION OF THE WORK JUNE 30, 1885.

There has been no work of improvement done at this harbor during the past year that affects the navigable condition of the harbor, which remains practically as reported June 30, 1884.

Under the project approved by the Chief of Engineers for the disbursement of the appropriation for this harbor, contained in the river and harbor act approved July 5, 1884, proposals were solicited and received for rebuilding the superstructure over 340 linear feet of the north pier, as follows:

Abstract of proposals received and opened August 29, 1884, for improving the harbor at Racine, Wis. (cutting down and rebuilding 340 feet of superstructure of the north pier, with pile protection).

No.	Names and residences of bidders.	Pine timber, per thousand feet, 104,000 feet, B. M.	Pine plank, 3 inches, per thousand feet, 6,300 feet, B. M.	Iron drift-bolts, per pound, 14,500 pounds.	Iron screw-bolts, per pound 1,150 pounds.	Iron spikes, per pound, 8 inches, 450 pounds.	Stone ballast, per cord, 40 cords.	Oak timber, in place, per thousand, feet, 4,500 feet, B. M	Oak piles, in place, per linear foot, 1,152 linear feet.	Framing, per thousand feet, 104,000 feet, B. M.	Total cost of 340 feet of superstructure, with pile protection.
				Cts.	*Cts.*	*Cts.*			*Cts.*		
1	Knapp & Gillen, Racine, Wis	$16 50	$16 25	3½	6	5	$10 50	$50	40	$17 50	$5,343 17
2	Christopher H. Starke, Milwaukee, Wis	17 00	16 00	3½	6	5	11 50	45	40	18 50	5,515 10
3	George H. Sager, Kenosha, Wis	16 50	13 00	4	5	5½	10 00	43	35	12 00	4,704 85

With the approval of the Chief of Engineers, contract was entered into September 22, 1884, with George H. Sager, the lowest responsible bidder for this work, who has satisfactorily completed the work during the year.

PROPOSED APPLICATION OF FUNDS ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

It is proposed to expend these funds in dredging, in extending the south pier, and in current repairs. The project for extending the south pier is contained in the Annual Report of the Chief of Engineers for 1883. The work is necessary for arresting the drift of sand into the harbor, and to reduce the funnel-shaped entrance to prevent disturbance within the harbor by waves entering the present wide mouth. This work, however, is not urgent and may be delayed. The dredging, however, should be done at the earliest practicable moment.

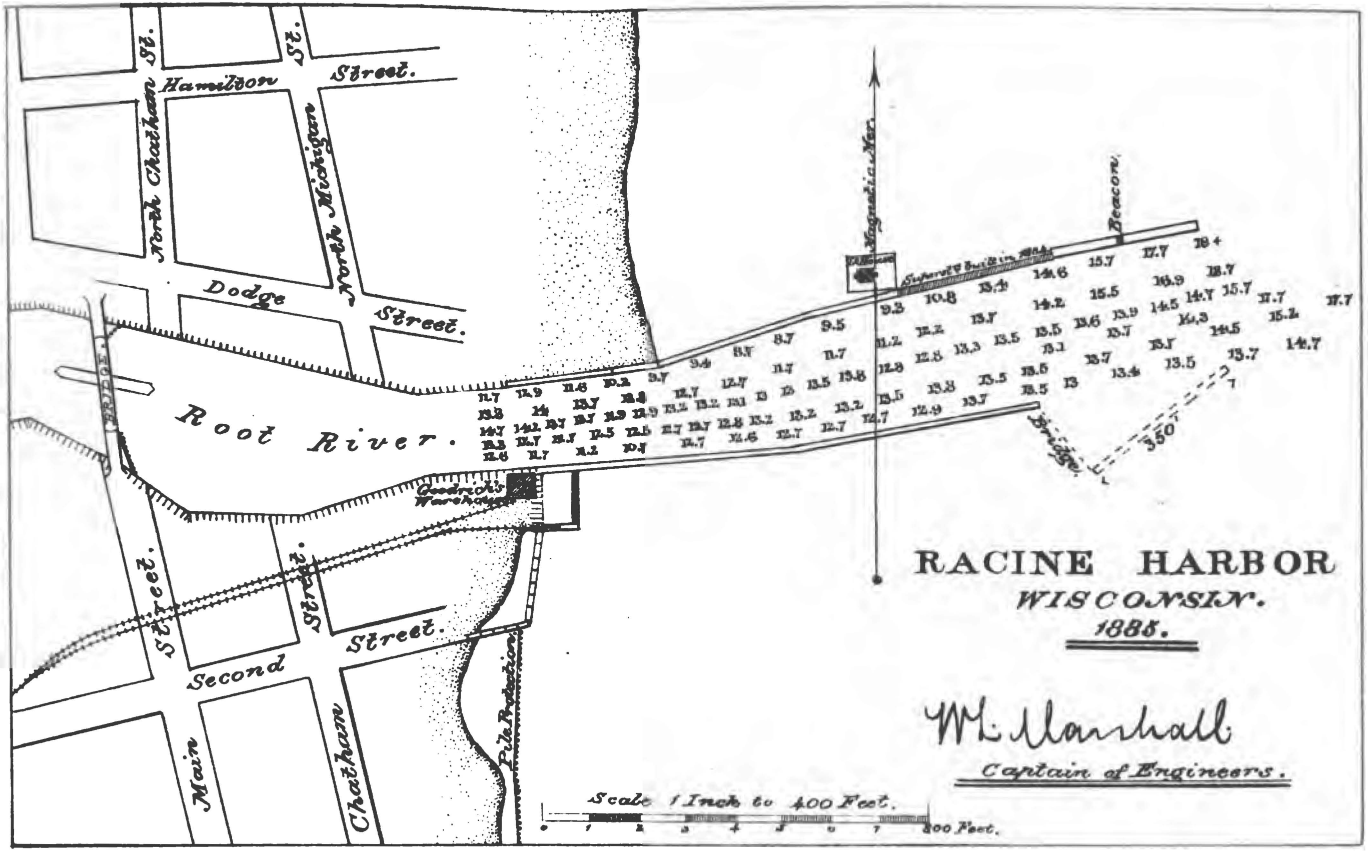
The report, herewith, of Assistant Engineer W. H. Hearding will give the details of the work done at this harbor during the fiscal year ending June 30, 1885.

The nearest collection district is Milwaukee, Wis. The nearest port of entry is Milwaukee, Wis. Amount of revenue collected at the nearest port of entry during the last fiscal year, $193,553.30.

Money statement.

July 1, 1884, amount available	$2,379 94
Amount appropriated by act approved July 5, 1884	7,000 00
	9,379 94
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	5,797 76
July 1, 1885, amount available	3,582 18
Amount (estimated) required for completion of existing project	35,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	28,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.



RACINE HARBOR

WISCONSIN.

1885.

W. L. Marshall

Captain of Engineers.

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REPORT OF MR. W. H. HEARDING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Milwaukee, June 30, 1885.

SIR: The following report upon the harbor of Racine, Wis., for the fiscal year ending this date is respectfully submitted. By act of Congress approved July 5, 1884, the sum of $7,000 was appropriated for the improvement of this harbor. Proposals were received in response to advertisement in the daily papers for cutting down and rebuilding a section of the superstructure of the north pier, 340 running feet in length, commencing at a point opposite the light-house crib and extending eastward.

The work was awarded to the lowest bidder, Mr. G. H. Sager, of Kenosha, Wis., who entered into a contract for the performance of the same on the 22d day of September, 1884.

With the exception of bolting and fastening to the new superstructure thirty-six fender-piles which he had driven and laying the planks for foot-walk, he had completed the work by the first week in December.

The average height of this new work is 6¼ feet, its width being 20 feet. The timbers of the trestle-work carrying the foot-walk over this section from the light-house crib to the beacon light were found to be in such a condition as would not admit of their being replaced, and new materials were of necessity substituted for its reconstruction, the cost of which was defrayed by the Light-House Department. As soon as the ice had left the pier this spring the work remaining to be done was satisfactorily performed and the contract of Mr. Sager closed.

A plat of the soundings taken by me on the 13th ultimo shows that the quantity of sand deposited in the channel since soundings were taken in 1884 has not been quite as great as in some former years. At the stage of water which prevailed when the soundings were made (1.3 feet above datum) vessels drawing not more than 13 feet of water can enter the harbor safely during fair weather.

If the water-level should be lowered to the extent of a foot, dredging would be necessary to provide a channel for the class of vessels which frequent this harbor, many of them being of large tonnage capacity.

I have not been able to obtain statistics of the trade which is transacted at Racine, but it is said to be increasing, notwithstanding the depression which has generally prevailed in business for the past two years.

The arrivals and departures at this harbor during the past fiscal year, as per information furnished by A. W. Hall, esq., collector, were as follows:

Arrivals and departures.	Number.	Tonnage.
Arrivals of steamer	479	293,421
Arrivals of sail-vessels	438	66,694
Total	917	360,115
Departures of steamers	478	286,471
Departures of sail-vessels	439	66,623
Total	917	353,094

I have the honor to subscribe myself, very respectfully, your obedient servant,

W. H. HEARDING,
Assistant Engineer.

Capt. W. L. MARSHALL,
Corps of Engineers, U. S. A.

I I 4.

IMPROVEMENT OF KENOSHA HARBOR, WISCONSIN.

CONDITION OF THE WORK JUNE 30, 1885.

In accordance with the project approved by the Chief of Engineers for the disbursement of the appropriation for this harbor, contained in the river and harbor act approved July 5, 1884, proposals for building superstructure over 355 linear feet of the south pier, by contract, were invited and received and opened, as follows:

Abstract of proposals received and opened August 29, 1884, for improving harbor at Kenosha, Wis., cutting down and rebuilding superstructure of outer section of south pier.

No.	Names and residences of bidders.	Pine timber per 1,000 feet, 84,000 feet B. M.	Pine plank, 3 inches, per 1,000 feet, 3,150 feet B. M.	Iron drift-bolts, per pound, 12,000 pounds.	Iron spikes, 8 inches, per pound, 350 pounds.	Stone ballast, per cord, 50 cords.	Framing, per 1,000 feet, 84,000 feet B. M.	Total cost of 355 feet of superstructure.
				Cents.	*Cents.*			
1	Knapp & Gillen, Racine, Wis	$16 75	$16 50	3½	5½	$11 00	$13 50	$3,582 22
2	Christopher H. Starke, Milwaukee, Wis	17 00	16 00	3½	5	12 00	14 50	3,733 90
3	George H. Sager, Kenosha, Wis	16 50	13 00	4	5	10 00	11 00	3,348 45

With the approval of the Chief of Engineers, contract was entered into September 22, 1884, with George H. Sager, the lowest responsible bidder, for this work, which was executed during the year, and the contract closed.

The condition of the harbor is given in the report of Assistant Engineer W. H. Hearding, and map herewith.

PROPOSED APPLICATION OF FUNDS ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

These funds are to be used in rebuilding the superstructure over 415 linear feet of the inner section of the south pier, in maintaining the present channel or entrance, and in extending the south pier. The pier extension is not urgent, but the dredging should be done at the earliest moment.

The nearest collection district is Milwaukee, Wis. The nearest port of entry is Milwaukee, Wis. Amount of revenue collected at the nearest port of entry during the last fiscal year, $193,553.30.

Money statement.

July 1, 1884, amount available	$949 38
Amount appropriated by act approved July 5, 1884	5,000 00
	5,949 38
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,113 31
July 1, 1885, amount available	1,836 07
Amount (estimated) required for completion of existing project	46,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00

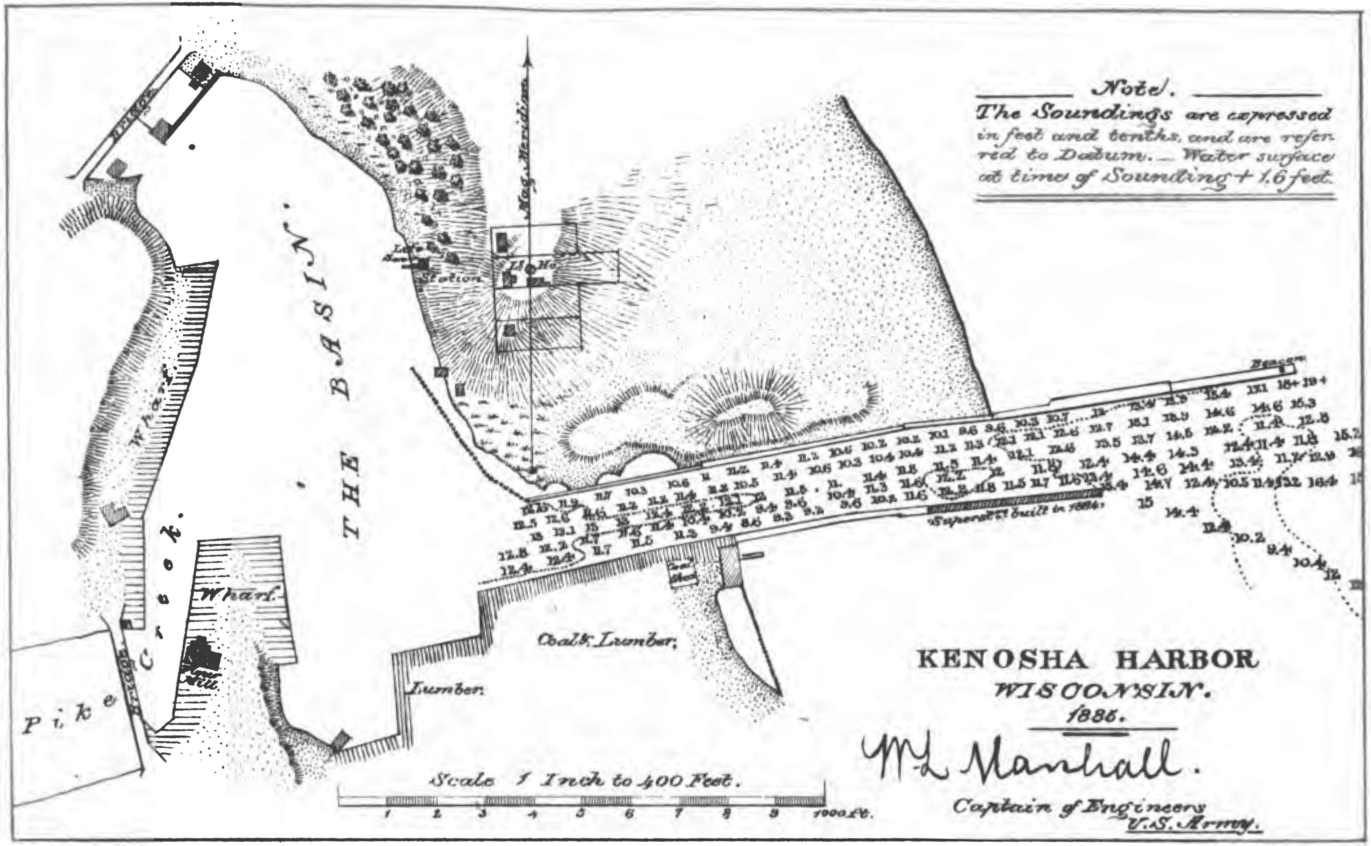
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. W. H. HEARDING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Milwaukee, June 30, 1885.

SIR: The following report in relation to Kenosha Harbor, Wisconsin, is respectfully submitted:

By act of Congress of July 5, 1884, the sum of $5,000 was appropriated for the improvement of this harbor. In answer to advertisements inserted in the daily papers, requesting proposals for cutting down and reconstructing superstructure over the outer section of the south pier, 355 feet in length, bids were received, of which that



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of Mr. George H. Sager, of Kenosha, was the lowest, and a contract was entered into by him for doing the work on the 22d day of September, 1884. The work was commenced on the 5th day of November, and, owing to exceptionally fine weather, was completed in a satisfactory manner on the 13th of December, with the exception of putting into the pier the required amount of stone-ballast. This was not supplied until the 9th day of last month, when 37 cords of that material were placed in the work. The average height to which the new superstructure has been built is 5 feet; its width being 20 feet.

Parties claiming ownership to the lake frontage, on the north side of the north pier, have taken large quantities of gravel from the beach for shipment to Chicago. The shore line, however, extends 25 feet further into Lake Michigan than it did in 1884, through the accretions of last winter.

The accompanying plat of soundings, which were taken by me on the 18th instant, shows that at the present stage of water (+ 1.6 feet), vessels drawing not more than 12 feet can enter the harbor safely in calm weather.

The arrivals and departures of vessels during the past fiscal year were as follows, as per information kindly furnished by A. W. Hall, esq., collector:

Arrivals and departures.	Number.	Tonnage.
Arrivals of steamers	99	11,884
Arrivals of sail vessels	134	17,906
Total	233	29,790
Departures of steamers	90	11,626
Departures of sail vessels	138	17,351
Total	228	28,977

I have the honor to subscribe myself, very respectfully, your obedient servant,

W. H. Hearding.

Capt. W. L. Marshall,
Corps of Engineers, U. S. A.

I I 5.

IMPROVEMENT OF WAUKEGAN HARBOR, ILLINOIS.

CONDITION OF WORK JUNE 30, 1884, AND PROGRESS MADE DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

The condition of the work is shown by the accompanying maps, and the detailed report of work done is given in the report of Assistant Engineer W. H. Hearding, herewith.

During the fiscal year the north pier has been advanced 298 linear feet, and piles have been purchased for the completion of this pier when funds are available.

PROPOSED APPLICATION OF FUNDS ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

The funds now available will have been expended, reserving a small balance for watchman and contingent expenses and maintenance, by July 20, 1885. The funds asked for the fiscal year ending June 30, 1887, are to be used in the completion of the north pier and in dredging the entrance; a portion of the outer basin, to serve as a harbor during the construction of the inner basin, and in dredging and revetting the passage from the outer to the inner basin.

The work is not sufficiently advanced to be of any advantage to commerce. The harbor is being built at an exposed point in shallow water, remote from shelter, which makes its construction difficult and expensive.

The prospective commercial importance of the harbor is treated in the Annual Report of the Chief of Engineers for 1882, page 2165.

The object to be attained by the construction of this harbor and the desire of the citizens in reference to it are stated in the Report of the Chief of Engineers for 1880, pages 1940 to 1947.

At present there is but little transportation to and fro by water. Traffic by water is confined to lumber-carrying mainly, the boats landing at an exposed pier-head.

The nearest collection district is Chicago, Ill. The nearest port of entry is Chicago, Ill. Amount of revenue collected at the nearest port of entry during the last fiscal year, $4,133,845.11.

Money statement.

July 1, 1884, amount available	$798 54
Amount appropriated by act approved July 5, 1884	20,000 00
	20,798 54
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	15,044 38
July 1, 1885, amount available	5,754 16
Amount (estimated) required for completion of existing project	91,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	75,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. W. H. HEARDING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Milwaukee, June 30, 1885.

SIR: The following report upon the harbor at Waukegan, Ill., is respectfully submitted:

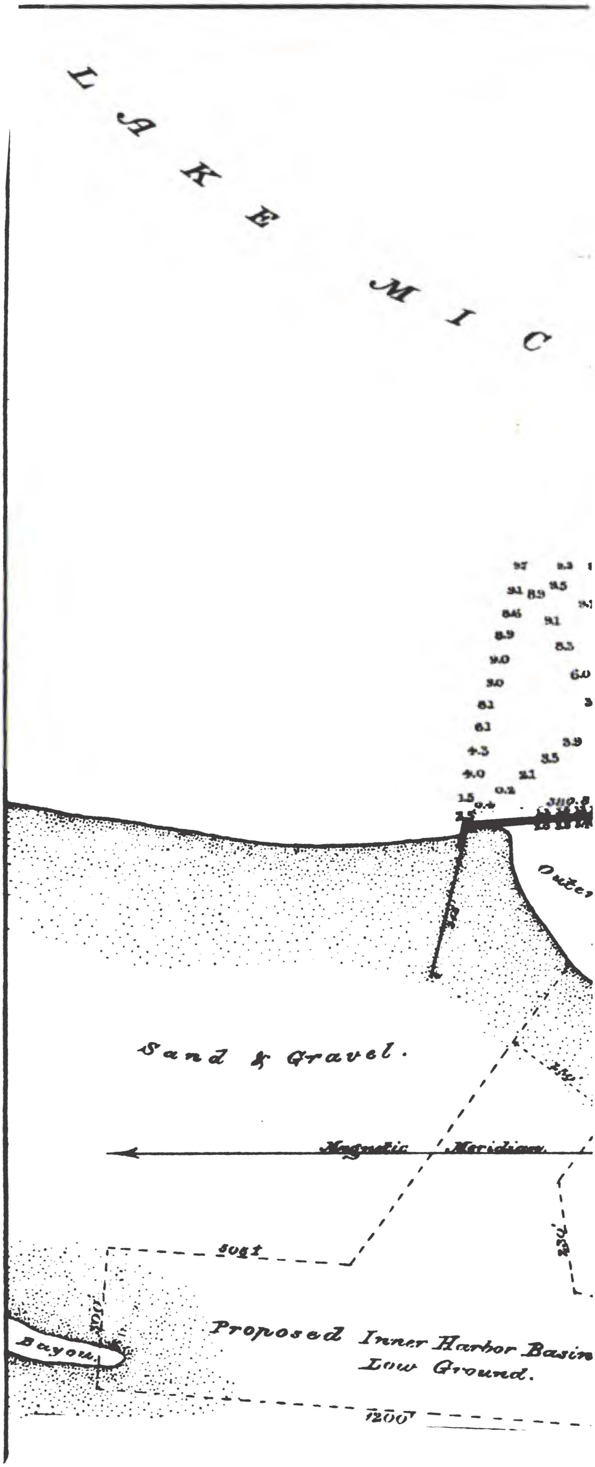
In the bill passed by Congress July 5, 1884, the sum of $20,000 was appropriated for the improvement of this harbor. Since July, 1882, the work has been done by hired labor, and purchase of materials in the open market.

As soon as the money appropriated became available, circulars were forwarded to all such parties in Wisconsin and Illinois as it was thought would be desirous of furnishing the necessary materials for the construction of a section of pile pier, and they were procured at fair rates.

The pile-driver was stationed on the shore on the alignment of the south pier, upon which it had been used in 1883. In order to take it across the basin to commence the construction of the north pier, foundation piles were driven from the shore to the south end of the east arm, on the proposed line of the north pier, the distance across being 370 feet. Cap timbers were laid on the piles for supporting the track timbers for the whole distance. The bridge thus constructed has been of great service in transporting materials of construction, fuel, &c., from the shore to the work, and will continue to be serviceable until the north pier is completed. The engine of the pile-driver was put in order and work was commenced on August 15, and continued until October 31, upon which date work was suspended for the season. Five sections of the north pier were constructed, in length 170 running feet.

The quantity of stone required for the work is in excess of the estimates. This excessive quantity is due to the mobility of the material overlying the clay of the lake bed, which is 19 feet below the plane of reference for the water level of Lake Michigan. The movable material is a deposit of sand and gravel. A description of the effect of a storm which occurred October 7, last, will be sufficient to illustrate its changeableness. The piles had just been driven for section 3 of the north pier, and were secured with wales, rods, binders, and struts, placed from binder to binder, but the stone ballast had not been supplied. The water in which these piles were driven was from 6 to 9 feet in depth, both in and outside the pier.

The storm was from the northeast and was of not more than thirty hours' duration. After it had subsided, the depth of water inside the section was 18 feet, and from 17 to 19 feet outside, so that during this short period of time, a volume of this overlying


L A K E   M I C
Outer
Sand & Gravel.
Magnetic Meridian
809 ft
330'
150'
Bayou.
Proposed Inner Harbor Basin
Low Ground.
1200'

material of more than 10 feet in thickness had been removed by the action of the water. The only effective method of supplying a deficiency thus caused, is to fill the excavated space with stone. By this method the work as far as it has been accomplished has been satisfactorily sustained. At the close of operations such repairs as were necessary to the engine of the pile-driver were made.

During the winter oak piles were purchased at very favorable rates, for the work of 1885, and as the pier extended to such a depth of water as to permit vessels to discharge stone directly into it without running excessive risk; stone has been obtained at much more favorable rates this year than it has heretofore.

The work up to this time has been prosecuted under great disadvantages, which are only fully understood by persons who are conversant with the difficulties attending the construction of such a work in shoal water, upon such an exposed coast, and at a distance from shelter.

Work was resumed upon the extension of the north pier on the 25th day of last month, and up to this time four sections, Numbers 6, 7, 8, and 9, equal to 128 running feet in length, have been built. It is expected that one more section of 32 feet in length will be completed by the 16th of July, when operations will be suspended.

The accompanying plat which shows the work done during the past fiscal year, and the soundings taken by me on the 23d instant, also illustrates the advantage gained by an increased depth of water to the southward of the new work.

The work of construction has been ably conducted under the immediate supervision of Mr. Hugh Gillen.

The number of steamers and sailing vessels which arrived and discharged cargoes at the bridge pier during the year was 65, the number of departures 65. The receipts and shipments of merchandise and products are chiefly conducted by railroad.

I have the honor to subscribe myself, very respectfully, your obedient servant,

W. H. HEARDING,
Assistant.

Capt. W. L. MARSHALL,
Corps of Engineers, U. S. A.

I I 6.

IMPROVEMENT OF THE FOX AND WISCONSIN RIVERS, WISCONSIN.

During the fiscal year ending June 30, 1885, the work on the Fox and Wisconsin rivers improvement has been restricted from lack of funds, the appropriation made in the river and harbor act approved July 5, 1884, not being available until the cost of the necessary lands and sites for the Menasha Dam may be determined.

Detailed statements of all work done during the year are given in the reports of Assistant Engineer C. A. Fuller and Overseer J. W. Allen, jr., herewith.

On the Wisconsin River a small party was employed in the months of August and September in repairing the dams in the improved section of the river just below Portage. A rise in the river put an end to this work, after eight dams had been repaired, September 13, 1884.

No work is contemplated on the Wisconsin River beyond keeping in repair the dams already built over the improved section until the question of their efficacy in improving the navigation of the river is determined.

On the Upper Fox the necessary work for maintaining the navigation of the river from Portage to Lake Winnebago, including repairs to locks and dams and the maintenance of the existing channel by dredging, was done. The boats and dredges pertaining to the work were repaired, and 74,371 cubic yards of sand were dredged from twenty-three bars and shoals between Montello and White River locks.

On the Lower Fox thorough repairs were made to the old lock at Menasha and to Appleton fourth and Little Chute first locks. A new abutment was built for the Cedars Dam. A new abutment was built and an apron begun at Little Kaukauna Dam. The canals were deepened by rock excavation and dredging at Little Chute and Kaukauna, and more or less extensive repairs made to the locks, dams, and canal banks throughout the line.

Stone was quarried and cut for the abutments and sluice-ways of the proposed new dam at Menasha; for coping for the proposed stone lock at Menasha, and for new abutments for all dams where injured by washouts during the extraordinary floods of 1881–'82.

Navigation was continued throughout the season from Portage to Green Bay until suspended by ice, except through the Menasha Lock, which failed and was closed for repairs October 23, 1884. Three feet depth of navigation was maintained on the Upper Fox, and 5 feet on the Lower Fox, save at Menasha, where there is but 4½ feet depth.

All work of improving the navigation of the Fox and Wisconsin rivers done during the year has been paid for from the balance from the specific appropriation of August 2, 1882. The expense of maintaining the existing depth of navigation throughout the Fox River and canals; for repairs to old locks and dams, and for repairs to mechanical constructions that have been completed and in use, but afterwards injured by flood or otherwise, and for lock-keepers' services, have been paid from the indefinite appropriation for "Operating and care of canals and other works of navigation" provided by section 4 of the river and harbor act approved July 5, 1884. A detailed statement of the expenditures under this latter appropriation accompanies this report.

PROPOSED APPLICATION OF FUNDS AVAILABLE FOR EXPENDITURE DURING THE FISCAL YEAR ENDING JUNE 30, 1886.

The funds appropriated by the act of July 5, 1884, and the balance from former appropriations are to be used (1) for the purchase of the necessary lands and sites at the Menasha Dam as directed by the proviso attached to the river and harbor act approved July 5, 1884, and (2) for making the necessary changes at the outlets to Lake Winnebago for carrying into effect the proviso attached to the river and harbor act approved August 2, 1882, as recommended in the report of the Board of Engineers dated September 17, 1884, approved by the Secretary of War, December 10, 1884, and in deepening to 6 feet, by rock excavation, the channels of the Fox River at the outlet to Lake Winnebago at the head of Menasha Channel, and at De Pere, in accordance with the report of the Board of Engineers above mentioned, approved by the War Department December 10, 1884.

The proceedings for acquiring title to the necessary lands and sites at the Menasha Dam are about concluded, and this vexed question finally at rest.

Under the indefinite appropriation for the "operating and care of canals and other works of navigation," the locks at Governor Bend and Montello are to be thoroughly repaired; the existing depth of navigation maintained; current repairs to locks, dams, and canal banks made, and the works operated and cared for during the fiscal year ending June 30, 1886.

PROPOSED APPLICATION OF FUNDS ASKED FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

The estimate herewith submitted is for continuing the work under the project contained in the report of the Board of Engineers dated

September 17, 1884, approved by the Secretary of War December 10, 1884, which contemplates the replacement of the old locks (eight in number) on the Lower Fox, as they become unserviceable, with permanent works of stone; the rebuilding of the Appleton Lower Dam, and the deepening of the Fox River from Montello to Green Bay to 6 feet throughout, without reference to the original project which is now being considered by the Board of Engineers.

This work forms part of the original project, the object of which was to secure a cheap route of transportation from the Mississippi River to the Great Lakes and Atlantic seaboard, the advantages of which are set forth in numerous previous reports and especially in the report of Maj. G. K. Warren, Corps of Engineers, in the Report of the Chief of Engineers for 1868, page 357, and in the report of the Select Committee on Transportation Routes to the Seaboard, United States Senate, 1874.

The present status of this project may be seen from the report of the Board of Engineers to which the matter has been referred, contained in the Report of the Chief of Engineers, United States Army, of 1884. Appendix G G, page 1900, *et sequitur*.

With reference to this improvement it may be well to call attention to the fact that the capacity of the locks, as they now exist, exceeds the navigable capacity of the channel; in other words, vessels that draw the full depth of water on the miter-sills of the locks cannot pass the obstructions in the channels of the river. It is, therefore, advisable that the funds given by Congress should be applied first to the deepening of the river channels to the full capacity of the mechanical structures already existing, before improving the character of these constructions, in order that, should Congress fail to make appropriations for rebuilding the old locks with stone, the full benefit of the locks already built will remain available.

Detailed estimates of the cost of the work contemplated by the Board of Engineers of September 17, 1884, have not been completed as yet. The estimate for the completion of the original project is, therefore, adhered to below.

The nearest collection district is Milwaukee, Wis. The nearest port of entry is Milwaukee, Wis. Amount of revenue collected at the nearest port of entry during the last fiscal year, $193,553.30.

Money statement.

July 1, 1884, amount available	$66,903 31
Sale of fuel to officers	105 00
Amount appropriated by act approved July 5, 1884	160,000 00
	227,008 31
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	51,332 93
July 1, 1885, amount available	175,675 38
Amount (estimated) required for completion of existing project	1,965,663 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	300,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

OPERATING AND CARE OF CANALS AND OTHER WORKS OF NAVIGATION APPLIED TO FOX AND WISCONSIN RIVERS, WISCONSIN, SECTION 4 RIVER AND HARBOR ACT JULY 5, 1884.

Detailed statement of expenditures for fiscal year ending June 30, 1885, *with itemized statement of expenses attached, as required by above act of July* 5, 1884.

Repairs of dams, Wisconsin River:		
Labor	$240 05	
Stone, brush, &c	404 82	
		$644 87
General repairs of locks, dams, and canals, Upper Fox:		
Labor	2,198 85	
Materials, supplies, and transportation	410 15	
		2,609 00
Dredging bars in channel, Upper Fox: Labor and supplies with dredge and boat		1,875 27
Repairs of Governor Bend Lock: Materials, supplies, and transportation		627 97
Repairs of lock-house at Eureka		25 00
General repairs of locks, dams, and canals, Lower Fox:		
Labor	$1,719 55	
Repairs and supplies, running dredges and boats	840 63	
Materials, supplies, and transportation	1,570 86	
		4,131 04
Quarrying stone for repairs of dams, Lower Fox:		
Labor	3,254 57	
Materials, supplies, and transportation	508 41	
		3,762 98
Dredging in channels, Lower Fox:		
Labor	394 58	
Repairs and supplies of boats and dredges	212 06	
		606 64
Repairs of Menasha Lock:		
Labor	4,536 50	
Materials, supplies, and transportation	2,083 05	
		6,619 55
Rent of lock-house at Appleton		90 00
Repairs of Appleton third lock:		
Labor	1,098 05	
Materials, supplies, and transportation	912 55	
		2,010 60
Repairs of Appleton fourth lock:		
Labor	2,278 57	
Materials, supplies, and transportation	3,732 26	
		6,010 83
Repair of Cedars Dam:		
Labor	3,172 67	
Materials, supplies, and transportation	327 55	
		3,500 22
Repairs of Kaukauna fifth lock:		
Labor	294 79	
Materials, supplies, and transportation	688 41	
		983 20
Repairs of Little Kaukauna Dam:		
Labor	3,449 61	
Materials, supplies, and transportation	4,726 13	
		8,175 74
Lock-tenders' services		3,398 31
Superintendence and traveling expenses		1,121 30
Gauge-keepers' services		135 00
Watchmen's services		240 83
Stationery		119 05
		46,687 40

Itemized statement of expenses made from appropriation for operating and care of canals and other works of navigation, indefinite; act of July 5, 1884, applied to Fox and Wisconsin rivers, Wisconsin.

Date.		Number of voucher.	To whom paid.	For what paid.	Amount.
1884.					
Sept.	3	1	William Edwards	Services	$35 00
	3	2	Richard E. Rice	do	16 00
	3	3	Martin D. Leonard	do	30 00
	3	4	John Lewis	do	30 00
	3	5	Gottlieb Jahnke	do	30 00
	3	6	Gabriel Wick	do	30 00
	3	7	John A. Banker	do	30 00
	3	8	George Gifford	do	30 00
	5	9	C. A. Fuller	Traveling expenses	13 35
	5	10	Robert Herman	do	8 20
	5	11	Charles M. Cole	do	9 80
	5	12	Samuel Whitney	do	5 30
	6	13	Hired men	Services, August	5,073 24
	6	14	Hired men	do	107 55
	6	15	David Harvey	Labor	27 50
	17	16	Clarence L. Neff	do	19 50
	17	17	L. K. Neff	Services	10 00
	17	18	Alexander Turriff	Labor	3 00
	17	19	McKenzie & Crawford	Coal	23 75
	17	20	Albert Sanford	Pike poles	73 20
	17	21	Briggs. Wharton & Beveridge	Lumber	11 10
	17	22	Miller & Blood	Coal	36 20
	17	23	Jeremiah Kinney	Lumber	191 35
	17	24	Morgan & Bassett	Iron, labor, &c	395 31
	17	25	H. A. Foster	Oil	10 93
	17	26	E. M. Thein	Iron pipe, &c	51 28
	17	27	John Schlosser	Spikes, iron, &c	409 35
	17	28	P. D. Norton	Lumber	98 68
	17	29	Butler Brothers	Paint, oil, &c	10 18
	17	30	Peter Reuter	Wood	24 00
	17	31	P. W. Freese	Hire of pile-driver and saw	255 00
	17	32	Harris & Williams	Lumber and freight	705 26
	17	33	G. D. Norris & Co	Rope	42 60
	17	34	H. McGowan	Stone	125 00
	17	35	L. D. Comstock	do	162 50
	17	36	G. D. Norris & Co	Rope	44 01
	17	37	Guthrie & Buell	Coal	99 84
	17	38	A. L. Smith	Stone	173 96
	17	39	L. D. Comstock	Stone and team-hire	310 50
	17	40	Guthrie & Buell	Coal	75 95
	17	41	G. D. Norris & Co	Rope, wire, &c	18 37
	30	42	George Gifford	Services	30 00
Oct.	3	1	Robert Herman	Traveling expenses	4 55
	3	2	Samuel Whitney	do	4 50
	4	3	Hired men	Services, September	5,151 76
	7	4	Jeremiah Kinney	Lumber	689 59
	7	5	Morgan & Bassett	Bolts, iron, &c	252 42
	7	6	John Schlosser	Nails, iron, &c	69 60
	7	7	Butler Brothers	Iron, rope, &c	34 42
	7	8	A. L. Smith	Hire of house	45 00
	7	9	H. A. Foster	Oil	14 90
	7	10	Louis Clermont	Clay and stone	576 00
	7	11	Lucien Hendricks	Wood	94 50
	7	12	John F. Parker	do	10 78
	7	13	Fred R. Hjorth & Sons	Rollers	28 40
	7	14	N. S. Wight	Piles	1,324 80
	7	15	F. Hurlbut	Coal	93 35
	7	16	G. D. Norris & Co	Rope	43 75
	7	17	George H. Paul	Cement	176 09
	7	18	H. Bosworth & Sons	Oil	33 07
	7	19	E. S. Purdy	Oil, &c	5 81
	7	20	Niels Johnson	Steel, labor, &c	31 75
	14	21	Daniel Pendergast	Services	32 55
	14	22	Nelson Corrow	do	8 75
	14	23	J. W. Flack	do	15 40
	14	24	Mary Langdon	do	6 66
	28	25	J. W. Allen, jr	Traveling expenses	18 65
	31	26	J. W. Allen, jr	Services	155 00
	31	27	William Edwards	do	35 00
	31	28	Richard E. Rice	do	16 00
	31	29	Martin D. Leonard	do	30 00
	31	30	John Lewis	do	30 00
	31	31	Gottlieb Jahnke	do	30 00
	31	32	Gabriel Wick	do	30 00
	31	33	John A. Banker	do	30 00
	31	34	George Gifford	do	30 00
	31	35	Patrick O'Leary	do	35 00

Itemized statement of expenses made from appropriation for operating and care of canals and other works of navigation, &c.—Continued.

Date.	Number of voucher.	To whom paid.	For what paid.	Amount.
1884.				
Oct. 31	36	Joseph Ikerman	Services	$35 00
31	37	G. B. Varney	Team hire and labor	22 50
Nov. 5	1	Julius F. Hayes	Services	6 30
5	2	Ernest Frisener	......do	5 55
6	3	Hired men	Services, October	4,452 87
7	4	C. A. Fuller	Traveling expenses	9 50
7	5	Samuel Whitney	......do	4 35
7	6	Des Forges & Co	Stationery	67 30
7	7	Andrew O'Connell	Services	7 00
10	8	Jerry Parkinson	......do	51 50
10	9	Oswolt Hinickle	......do	24 00
12	10	Robert Herman	Traveling expenses	5 65
12	11	Patrick Boyce	Sand	62 40
12	12	E. D. Smith	Sawdust	2 50
12	13	Jeremiah Kinney	Timber	400 40
12	14	Morgan & Bassett	Labor	5 00
12	15	Butler & White	Stoves	18 97
12	16	H. A. Foster	Oil	7 95
12	17	John Schlosser	Iron, ropes, &c	116 24
12	18	E. M. Thein	Iron pipe, &c	11 50
12	19	Arnold Nelessen	Wood	103 25
12	20	Louis Clermont	Stone and clay	485 80
12	21	August Tetzloff	Clay	45 00
12	22	William Maass	Wood	62 40
12	23	John Arneill	......do	42 75
12	24	F. Hurlbut	Coal	8 00
12	25	L. D. Comstock	Team hire	6 00
12	26	J. F. Culver	Freight	16 00
12	27	Priest & Gorrow	Poles	40 00
12	28	P. B. Yates	Steel, packing, &c	7 35
12	29	C. A. Peck	Oil, labor, &c	12 14
12	30	W. B. Dodge	Wood	112 50
12	31	Frank Wick	......do	57 50
12	32	Mueller Brothers	Expenses charges	3 45
15	33	Dwight Gifford	Mortar, nails, &c	25 00
29	34	Hired men	Services, November	428 97
30	35	J. W. Allen, jr	Services	150 00
30	36	William Edwards	......do	35 00
30	37	Richard E. Rice	......do	16 00
30	38	Martin D. Leonard	......do	30 00
30	39	John Lewis	......do	30 00
30	40	Gottlieb Jahnke	......do	36 00
30	41	Gabriel Wick	......do	30 00
30	42	John A. Banker	......do	30 00
30	43	George Gifford	......do	30 00
30	44	Patrick O'Leary	......do	35 00
Dec. 3	1	John M. Paige	......do	34 16
3	2	Robert Herman	Traveling expense	7 30
3	3	Samuel Whitney	......do	8 40
5	4	Hired men	Services, November	1,858 50
6	5	Friedrich A. Thoermer	Services	25 00
6	6	Martin T. Battis	Traveling expenses	4 20
6	7	Martin T. Battis	Iron, labor, &c	286 10
6	8	Milmine & Harbeck	Nails, bolts, &c	4 58
6	9	J. F. Joslyn	Labor	3 50
6	10	P. D. Norton	Lumber	67 24
6	11	Jeremiah Kinney	Lumber	335 87
6	12	J. H. Marston & Co	Wood	19 80
6	13	H. A. Foster	Oil, &c	9 71
6	14	John Schlosser	Nails, &c	46 79
6	15	Morgan & Bassett	Iron, labor, &c	133 08
6	16	Eliza Thoermer	Wood	83 88
6	17	F. Hurlbut	Coal	88 00
6	18	Theodore P. Greene	Sand	20 00
9	19	Andrew O'Connell	Services	10 00
10	20	Alfred J. Barlow	......do	6 00
31	21	George Gifford	......do	25 00
31	22	William Edwards	......do	35 00
31	23	John Kilawee	......do	15 00
31	24	James Clear	......do	35 00
31	25	John M. Paige	......do	30 00
1885.				
Jan. 3	1	Robert Herman	Traveling expenses	6 20
5	2	Hired men	Services, December	1,861 57
7	3	McKenzie & Crawford	Transportation	3 50
7	4	J. F. Joslyn	Bolts, labor, &c	74 98
7	5	Bachelder & Fisher	Coal	45 00

Itemized statement of expenses made from appropriation for operating and care of canals and other works of navigation, &c.—Continued.

Date.	Number of voucher.	To whom paid.	For what paid.	Amount.
1885.				
Jan. 7	6	Samuel F. Henry	Oil, &c	$7 95
7	7	R. A. Williams	Nails, labor, &c	3 45
7	8	P. D. Norton	Lumber, &c	523 79
7	9	W. H. Kelly & Co	Labor	3 17
7	10	A. L. Smith	Hire of house	45 00
7	11	H. A. Foster	Oil	6 26
7	12	Morgan & Bassett	Iron, labor, &c	5 55
31	13	E. M. Thein	Iron pipe, &c	7 13
31	14	John Schlosser	Spikes, nails, &c	179 46
31	15	Jeremiah Kinney	Lumber, &c	167 20
31	16	William Edwards	Services	35 00
31	17	John A. Banker	......do	30 00
31	18	George Gifford	......do	25 00
31	19	John Kilawee	......do	15 00
31	20	Alexander Sims	......do	25 00
31	21	John M. Paige	......do	30 00
Feb. 3	1	Bachelder & Fisher	Coal	22 50
3	2	J. F. Joslyn	Bolts, &c	14 46
3	3	Samuel F. Henry	Oil, &c	3 33
3	4	John Strange	Lumber	148 10
3	5	Crawford & Thomas	Coal	9 68
3	6	Jeremiah Kinney	Lumber	85 82
3	7	G. N. Richmond & Brother	Clay	80 00
3	8	H. H. Greene	Stone	14 00
3	9	Morgan & Bassett	Bolts and nuts	9 94
3	10	H. A. Foster	Ink and oil	5 35
3	11	John Schlosser	Spikes, &c	104 63
3	12	Henry Sherry & Co	Lumber	501 38
4	13	Hired men	Services, January	1,545 17
4	14	Robert Herman	Traveling expenses	7 80
28	15	William Edwards	Services	35 00
28	16	John A. Banker	......do	30 00
28	17	George Gifford	......do	25 00
28	18	John Kilawee	......do	15 00
28	19	John M. Paige	......do	30 00
Mar. 2	1	Robert Herman	Traveling expenses	3 90
3	2	Hired men	Services, February	1,179 29
4	3	Samuel F. Henry	Oil, &c	2 30
4	4	Bachelder & Fisher	Coal	25 40
4	5	J. F. Joslyn	Bolts, &c	33 61
4	6	John Strange	Lumber	146 57
4	7	Schlafer, Barrett, & Tesch	Spikes	3 39
4	8	H. A. Foster	Oil	4 85
4	9	Richard Miller	Washers and labor	4 48
4	10	Morgan & Bassett	Bolts, iron, &c	5 81
4	11	Henry Lasselyong	Wood	28 75
4	12	Jeremiah Kinney	Lumber	37 64
4	13	John Schlosser	Spikes, &c	42 81
9	14	Erskine E. Bailey	Services	50 00
9	15	C. A. Fuller	Traveling expenses	14 60
27	16	Joseph Holbrook	Timber	1,768 76
31	17	J. W. Allen, jr	Services	155 00
31	18	C. A. Fuller	......do	200 00
31	19	William Edwards	......do	35 00
31	20	John A. Banker	......do	30 00
31	21	George Gifford	......do	25 00
31	22	Alexander Sims	......do	25 00
April 2	1	Des Forges & Co	Stationery	28 50
2	2	Robert Herman	Traveling expenses	5 20
3	3	John Strange	Lumber	12 00
3	4	Samuel F. Henry	Oil	9 30
5	5	Bachelder & Fisher	Coal	21 75
5	6	Butler & White	Nails, iron, &c	60 25
5	7	Ramsay & Jones	Lumber	169 48
5	8	Morgan & Bassett	Iron, bolts, &c	59 17
5	9	J. W. Black	Wood	41 50
5	10	E. M. Thein	Copper, labor, &c	3 67
5	11	Joseph Greulich	Oil	5 67
5	12	S. S. Sheldon	Coal	6 57
5	13	John Schlosser	Spikes, &c	20 27
5	14	George H. Paul	Cement	28 25
4	15	Hired men	Services, March	1,315 86
14	16	Obenberger Brothers	Iron, &c	465 33
14	17	George B. Carpenter & Co	Rope and oakum	141 30
30	18	J. W. Allen, jr	Services	150 00
30	19	William Edwards	......do	35 00
30	20	John A. Banker	......do	30 00
30	21	George Gifford	......do	25 00
30	22	John Kilawee	......do	4 00

Itemized statement of expenses made from appropriation for operating and care of canals and other works of navigation, &c.—Continued.

Date.	Number of voucher.	To whom paid.	For what paid.	Amount.
1885.				
April 30	23	John M. Paige	Services	$30 00
May 2	1	John Lewis	do	25 25
4	2	Gabriel Wick	do	13 75
4	3	Hired men	Services, April	1,814 26
6	4	Martin D. Leonard	Labor	6 35
6	5	Robert Herman	Traveling expenses	8 75
6	6	John Strange	Lumber	45 90
6	7	Morgan & Bassett	Iron, &c	44 93
6	8	John Schlosser	Iron	6 36
6	9	Charles Cavert	Gravel	10 66
6	10	H. A. Foster	Oil	4 85
6	11	Joseph Greulich	Paint, &c	84 00
6	12	Butler & White	Iron, &c	28 85
6	13	Ramsay & Jones	Lumber	15 04
6	14	Schlafer, Barrett & Tesch	Iron, spikes, &c	144 85
6	15	Kaukauna Lumber and Manufacturing Company.	Lumber	37 50
6	16	George H. Paul	Cement	17 88
6	17	Henry Sherry	Timber	150 64
6	18	L. D. Comstock	Labor	16 50
8	19	Herm Parr	Services	5 00
12	20	Rollin Gifford	do	6 75
12	21	C. E. Floyd	Wood, team hire, &c	11 00
12	22	Gottlieb Jahnke	Services	11 25
18	23	Hired men	Services, May	856 92
31	24	C. A. Fuller	Services	200 00
31	25	William Edwards	do	35 00
31	26	Richard E. Rice	do	16 00
31	27	John Lewis	do	30 00
31	28	Martin D. Leonard	do	30 00
31	29	Gottlieb Jahnke	do	30 00
31	30	Gabriel Wick	do	30 00
31	31	John A. Banker	do	30 00
31	32	George Gifford	do	30 00
31	33	Friedrich A. Thoermer	do	30 00
31	34	Alexander ims	do	30 00
31	35	John M. Paige	do	35 00
31	36	Samuel Whitney	Traveling expenses	4 00
31	37	Robert Herman	do	6 55
31	38	C. A. Fuller	do	11 10
31	39	J. W. Allen, jr	Services	155 00
June 2	1	Andrew O'Connell	do	10 00
2	2	Charles M. Cole	Traveling expenses	4 35
4	3	Hired men	Services, May	1,179 09
6	4	H. Collette	Lumber	217 35
6	5	C. A. Berthelet	Cement	16 68
8	6	E. S. Baker	Hay, &c	8 25
8	7	Bachelder & Fisher	Coal	2 40
8	8	Charles Sims	Spars	13 50
8	9	Ramsay & Jones	Lumber	230 26
8	10	Schlafer, Barrett & Tesch	Nails, &c	29 80
8	11	Crawford & Thomas	Coal	14 76
8	12	Valley Iron Works	Capstan drums	9 36
8	13	Morgan & Bassett	Iron, &c	1 81
8	14	John Schlosser	do	8 26
17	15	J. W. Allen, jr	Traveling expenses	24 10
19	16	C. A. Fuller	do	14 60
20	17	J. W. Allen, jr	Services	150 00
30	18	C. A. Fuller	do	200 00
30	19	William Edwards	do	35 00
30	20	Richard E. Rice	do	16 00
30	21	John Lewis	do	30 00
30	22	Martin D. Leonard	do	30 00
30	23	Gottlieb Jahnke	do	30 00
30	24	Gabriel Wick	do	30 00
30	25	John A. Banker	do	30 00
30	26	George Gifford	do	30 00
30	27	Friedrich A. Thoermer	do	30 00
30	28	Alexander Simms	do	30 00
30	29	John M. Paige	do	35 00
30	30	Andrew O'Connell	do	10 00
30	31	Des Forges & Co	Stationery	23 25
		Total		46,637 40

W. L. MARSHALL,
Captain of Engineers.

FOX RIVER.

REPORT OF MR. C. A. FULLER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Appleton, Wis., July 11, 1885.

CAPTAIN: I have the honor to submit the following report of operations on the improvement of the Lower Fox River for the fiscal year ending June 30, 1885.

Operations during the year were confined principally to making repairs to locks, dams, and canal banks; to deepening canals and river outlets to locks; to quarrying and dressing stone for locks and dams, and to making repairs to boats and dredges.

Navigation was continued until closed by ice on the 25th November, 1884, except through Menasha Lock, which was closed for repairs October 23; it was resumed in part May 1, 1885, and throughout the line the 11th of the same month, and maintained to the present date. Boats drawing 5 feet of water could run from Green Bay to Menasha, and 4½ feet thence to Oshkosh, during the whole season of navigation.

The following outline of operations at each point on the Lower Fox River, under separate heads, viz, "Operating and Care of Canals and other Works of Navigation" and "Improving Fox River," is respectfully submitted.

OPERATING AND CARE OF CANALS AND OTHER WORKS OF NAVIGATION.

(1) DE PERE DAM (NEW).

No work was done to this dam during the year. To complete it the flume-cribs should be planked and a clay and gravel backing put in.

(2) DE PERE LOCK (OLD).

Leaks through the canal-bank near the head of the lock were stopped and slight repairs made to the side-walls. Timber for new coping and planks for side walls have been purchased and delivered.

(3) LITTLE KAUKAUNA LOCK (OLD).

The spars and snubbing posts were repaired and the planking of side-walls respiked. A leak near the head of the lock was repaired.

(4) LITTLE KAUKAUNA DAM (NEW).

For the purpose of making the required repairs at the right end of this dam, a pile coffer-dam, 87 feet in length, between the dam and the right shore, was put in, and two low clay dams were built near the site of the abutment. The abutment, which had partially fallen down, was removed, and rebuilt with pitched-face stone laid in cement mortar; 163 cubic yards of clay was well puddled in its rear, and a slope-wall built, extending 40 feet up and along the right shore.

To strengthen the dam, an apron 15 feet wide its entire length, covered with 3-inch oak plank and resting on four rows of piles, is to be constructed; 225 linear feet of this apron is completed, the space under it filled with stone, the rubble-stone filling to the dam replaced, and the dam backed with clay and small stone as the work on the apron is finished; 145 additional linear feet of the apron is completed, except planking and filling with rubble-stone.

There were received for this work 593 linear feet of pitched-face, 270.2 linear feet of dimension, 1,678 cubic feet of backing stone, 144 cords of rubble-stone, 88,642 feet B. M. pine lumber, 10,800 feet B. M. white-oak lumber, 8,832 linear feet of piles, 2,850 pounds spikes, 803 drift-bolts, 42 screw-bolts, 2,355 cubic yards of clay, and 105 barrels of cement.

(5) RAPID CROCHE LOCK (OLD).

The left lower gate was repaired and four protection piles driven at the head of the lock.

(6) RAPID CROCHE DAM (NEW).

The washout at the right end of the dam remains in about the same condition as when last reported on, but the abutment, with a small portion of the dam, has fallen in, and will have to be rebuilt. As soon as the stage of water in the river will permit, a coffer-dam will be put in, extending from the dam to the right shore, preparatory to making the required repairs.

(7) KAUKAUNA FIFTH LOCK (OLD).

New lower gates were built and hung, capstan platforms repaired, new drums put on capstans, hand-rails and fenders placed on all the gates, and a leak near the head of the lock stopped.

There were purchased and received 6,000 feet B. M. pine lumber, 1,000 feet B. M. white oak timber, and four iron capstan-drums.

(8) KAUKAUNA FOURTH LOCK (NEW).

Five new arms were framed and placed in each of the lower gates, the gates newly planked, and hand-rails put on.

There were purchased and received 2,030 feet B. M. of pine lumber, 2,182 feet B. M. of dressed pine plank, and 244 pounds of iron.

(9) KAUKAUNA THIRD LOCK (NEW).

Five new arms were framed, placed, and secured in the right lower gate, the gate newly planked, and hand-rails put on the upper gates. The capstan platforms were repaired.

There were purchased and expended on this work 1,010 feet B. M. of pine timber and 1,090 feet B. M. of dressed pine plank.

(10) KAUKAUNA SECOND LOCK (OLD).

Forty linear feet of coping timbers and three cross-ties were framed, placed, and secured; one spar, three hand-rails, and two gate-fenders were put on, and the upper wing-walls repaired.

There were purchased and expended 575 feet B. M. of pine lumber.

(11) KAUKAUNA CANAL.

Slight repairs were made to the right bank of the fourth level. In the fifth level a leak and washout, through the right bank, was repaired, caused principally by an open seam in the bed-rock. The riprapping was removed, the seam closed by using one barrel of Portland cement, the washout filled with clay, well puddled, and the riprapping replaced.

(12) KAUKAUNA DAM (NEW).

No work was done on this dam during the year. The open sluiceway near the middle has no arrangement for closing it in low water, by needles or otherwise.

(13) LITTLE CHUTE COMBINED LOCKS (NEW).

Slight repairs to the gates and valve-chains were made.

(14) LITTLE CHUTE SECOND LOCK (NEW).

The gearings to the valve-shafts were repaired.

(15) LITTLE CHUTE CANAL.

In the second level repairs to canal bank were completed, 27 cubic yards of clay were placed, and 25 cords of stone riprapped.

(16) LITTLE CHUTE DAM (NEW).

Four hundred and thirty-two needles were framed and placed in the weir. A leak at the left abutment was stopped, and low places between the abutment and the adjacent mill-flume were filled in.

There were purchased and expended 4,723 feet B. M. pine lumber.

(17) CEDARS LOCK (OLD).

The planking of the left side-wall was repaired, and two gate spars made and attached.

(18) CEDARS DAM (NEW).

The coffer-dam put in near the right end of this dam was raised 3 feet and straightened; 230 linear feet of low clay coffer-dams were built around the side of the abutment, the water kept out by constant use of a centrifugal pump, loose rock and gravel taken out to bed-rock, foundations laid, and the abutment laid up with pitched-face stone and cement mortar. An embankment 12 feet wide on top, with side slopes of 1 on 3, containing 3,835 cubic yards of clay, well puddled, and its top raised to a height of 3 feet above extreme high-water level, was built between the abutment and the right bank of the river; 1,338 cubic yards of backing to the main dam were put in, 24 cords of rubble-stone were placed in the dam, the paving of the front and rear slopes repaired, and a leak near the left abutment stopped.

There were received for this work 523 linear feet of pitched-face, 270 linear feet of dimension, 1,602 cubic feet of backing stone, and 24 cords of rubble, 5,273 feet B. M. pine plank, 400 pounds of nails, and 105 barrels of cement.

(19) APPLETON LOWER DAM (OLD).

A leak at the right abutment was stopped. The coping timbers are gone from about two-thirds of the length of the dam, and will have to be replaced during the low-water season.

(20) APPLETON FOURTH LOCK (OLD).

Extensive repairs were made to this lock, as follows: Crib coffer-dams were put in above and below, ice cut and removed, and the water pumped out. The coping timbers, planking of the walls, and the upper tiers of posts were removed and replaced by new. The gates were taken out, repaired, and rehung. The hollow quoins were removed and new ones framed, replaced, and well backed with stone. Both miter-sills were repaired and securely bolted to bed-rock. The upper recess walls were replanked, the head-walls relaid, and the upper and lower wing-walls repaired. A break in the canal bank near the head of the lock was filled. The coffer-dams were taken out and the plant stored.

There were purchased and expended on this work 82,649 feet B. M. pine lumber, 3,272 feet B. M. white-oak timber, 1,303 pounds of drift-bolts, 586 pounds of screw-bolts, 2,947 pounds of spikes, 800 pounds of nails, 845 pounds of iron, 802 cubic yards of clay, and 45 barrels of cement.

(21) APPLETON THIRD LOCK (OLD).

The old gates were removed and new ones were built and hung. Cast-iron caps, hand-rails, and one diamond block were placed, 18 cubic yards of clay were filled in near the waste-wier, and 13 cubic yards of stone was relaid in the head-walls.

There were purchased and expended 20,174 feet B. M. white-oak timber, 3,684 feet B. M. pine planks, 3,698 pounds of iron, 910 pounds of castings, and 900 pounds of nails.

(22) APPLETON SECOND LOCK (NEW).

The walls above low-water line were repointed with Portland cement.

There were purchased and expended five barrels of Portland cement.

(23) APPLETON FIRST LOCK (NEW).

One of the upper capstan platforms was raised and repaired.

(24) APPLETON UPPER DAM (NEW).

The planking of the sluice-gates in places where it had been broken by ice during the winter was replaced by new, and slight repairs were made to the working gear.

(25) ALTERING MENASHA DAM (OLD).

No work has been done since its suspension by order of the circuit court of Winnebago County, Wisconsin.

(26) MENASHA LOCK (OLD).

Owing to the dangerous condition of this lock, navigation through it was suspended on the 23d of October, 1884. Crib coffer dams were put in above and below, and the water pumped out. The gates and hollow quoins were removed, repaired, and replaced. A crib was built and placed to support the lower miter-sill, the timber platform under the upper one was repaired, and both miter-sills were securely bolted.

Portions of the floor and side walls were stripped, and 8,972 superficial feet were double planked, 14 iron tie-rods were placed in the chamber walls, new posts and coping were put in the upper and lower recess walls, and the fore-bay was repaired. The breast wall was lowered 1.75 feet, and the head and upper and lower wing-walls were repaired. The washout under the lower miter-sill, and below it, was filled with hard-pan and stone, and an apron 50 feet long, double-planked, was built between the lower wing-walls. The lower recess-walls were underpinned with concrete and partly replanked. The capstan platforms and spars were repaired, hand-rails put on all the gates, the coffer-dams removed, and the plant stored.

There were purchased and expended on this work 70,297 feet B. M. pine and hemlock lumber, 590 feet B. M. white oak timber, 5,700 pounds of spikes, 600 pounds of nails, 924 pounds of iron, 884 pounds of screw-bolts, and 209 pounds of drift-bolts.

(27) DREDGING.

Dredge No. 1 put in the backing to the lower coffer-dam at Menasha Lock to the coffer-dam and main dam at Cedars, and removed the coffer-dams at Menasha and Appleton Fourth Locks.

IMPROVING FOX RIVER.

(1) ALTERING LITTLE KAUKAUNA DAM (NEW).

For the purpose of regulating the height of water in the pool above as well as to reduce the pressure on the dam during high water, the construction of a sluice-way or needle weir, 208 feet in length and about 2.8 feet in depth at its crest, has been commenced. A pile coffer-dam 140 feet in length has been put in, and the work of cutting down the dam and building the apron is begun. The crest timbers, stringers, and plank, for a length of 120 feet, have been removed.

There has been purchased and received for this work, 27,985 feet B. M. pine lumber, 250 pounds drift-bolts, and 150 pounds of spikes.

(2) KAUKAUNA QUARRY.

Work was resumed July 5, 1884; the pump and engine were placed, and the water pumped out. There were stripped and hauled away 8,097 cubic yards of hard-pan, 30,392 cubic feet of backing, and 37,177 of dimension stone were taken out and transported to the stone-yard; 9,475 linear feet of stone were dressed pitched-face for locks and dams, and the coping-stones for a new lock at Menasha, 2,806 superficial feet, and 19 inches thick, were bush-hammer dressed.

Work was suspended on the 24th of November, 1884, and has not since been resumed.

There were received 943 feet B. M. pine lumber, 244 pounds of iron, and 25 pounds of tool steel.

(3) KAUKAUNA FIRST LOCK (NEW).

Ninety-three linear feet of wall and 50 of steps coping were laid and doweled, twenty stone steps were set, and 4 cubic yards of masonry laid in the lower wing-walls; two iron snubbing-posts, four iron suspension columns, one iron capstan, six valve-gearings, and four gate-spars were placed and secured, and iron caps put on heel and toe posts of gates. One capstan platform was built, and the columns, posts, spars, &c., were painted; 4,226 cubic yards of clay embankment were placed in rear of the walls, completing the construction of this lock.

There were purchased and expended six maneuvering gears, 169 pounds of iron, 17 pounds of nuts, 2 kegs spikes, 5 gallons asphaltum, 37 pounds white-lead, and 2 gallons of boiled oil.

(4) ALTERING LITTLE CHUTE FIRST LOCK (OLD).

This lock is used as a guard, and in high water as a lift-lock, to reduce the pressure on the gates of the next lock below. In addition to making the repairs required, the head of the lock was raised above the level of extreme high water.

A crib coffer-dam was put in above the lock, and a drainage-ditch excavated through rock and gravel to the second lock. The gates were removed, repaired, and rehung, the hollow quoins taken out and replaced by new ones, well backed, and the miter-sills repaired and securely bolted to bed-rock. Old planking-posts, girts, and coping-timbers were removed and replaced by new, and six anchor-bolts were inserted in the side walls. The head walls were taken down to a depth of 5 feet and rebuilt to a height of 18 inches above that of the old ones, with cement, masonry, and dry stone, backed with clay well puddled. New crib wing-walls, in extension of the head walls, were put in, filled with stone, and planked on both sides, and the right upper bank was raised and riprapped. A portion of the breast-wall was taken down and relaid with cement masonry. New capstan platforms were built, gate-spars framed and placed, fenders and cast-iron caps put on gates, and new snubbing-posts placed. The lock-chamber was cleaned out and the coffer-dam removed.

There were purchased and expended on this work 60,813 feet B. M. dressed pine plank, 50,400 feet B. M. pine lumber, 3,400 pounds of spikes, 400 pounds of nails, 2,612 pounds of iron, 40 pounds of steel, 1,008 pounds of iron castings, 79 barrels of cement, 479 cubic yards of clay, 4 cords of stone, 210 pounds of giant-powder, 350 linear feet of safety-fuze, and 200 caps.

(5) ALTERING APPLETON UPPER DAM (NEW).

The five Taintor sluice-gates and fixtures were painted with 225 pounds of mineral paint, 25 pounds of white-lead, and 70 gallons of boiled oil.

(6) DEEPENING KAUKAUNA CANAL.

The third, fourth, and part of the fifth levels were deepened to 6 feet by excavating rock and removing bowlders and gravel. About 500 feet in length of the fifth level is yet to be dredged to complete its deepening to 6 feet; 1,663 cubic yards of gravel and bowlders were taken out and placed on the inner slopes of the canal-bank, and 2,242 cubic yards of rock were excavated and piled upon the banks ready for loading on the boats.

There were purchased and expended on this work 830 pounds of giant-powder, 4,400 linear feet of safety-fuze, 2,300 caps, 384 pounds of iron, 77 pounds of tool steel, and 1 ton of blacksmith's coal.

(7) DREDGING.

Dredge No. 2 excavated a cut in the Grignon Rapids, above Appleton, 500 feet long, 30 to 60 feet wide, and 4 feet deep, the material removed being mostly rocks, one of which measured 1.5 cubic yards. On completion of this work the boat was towed to Menasha, and commenced deepening the canal to 6 feet; 6,882 cubic yards of gravel and hard-pan were removed. Further progress was stopped at a point where the bottom was composed of hard-pan and cement rock, and the work was suspended until a dredge-bucket with steel teeth could be procured. The boat was towed to Appleton and removed bowlders, logs, &c., that obstructed the channel through the draws of the railroad bridge over the river at that point. On the 17th of September, 1884, the dredge was turned over to Col. J. W. Barlow, Corps of Engineers, for use on Lake Michigan Harbor improvements, and the crew transferred to Dredge No. 1.

Dredge No. 1 deepened the Kaukauna Canal at the upper end of the first level; removed the coffer-dam at Little Chute First Lock; deepened to 6 feet the third level of Little Chute Canal, one mile in length, and the river outlet to the Little Chute Combined Locks; removed logs and snags from the river outlet to the Appleton Third Lock, and commenced taking out snags, logs, bowlders, and rock from the river outlet to Cedar Lock.

(8) REPAIRS TO BOATS.

Dredge No. 1.—The sides and deck were calked, four braces framed in the crane, racks attached to the dipper-handle, and ratchets for spars put on. The turn-table was finished and a new steel mouth-piece attached to the dipper. The engine and machinery were set up and the repairs completed. There were purchased and expended 135 screw-bolts, 71 drift-bolts, and 77 pounds of iron.

Steamer Henrietta.—New white-oak guards were put on, the hull was calked above water-line, the deck repaired, and the outside of the boat painted. Thirty-nine new arms and fourteen buckets were placed in the water-wheel, the rudder-post and tiller were repaired, and two rows of stanchions placed in the hull.

Steam-launch General Meade.—The boat was hauled out, the boiler removed, inspected, condemned, and a new one purchased and put in. The hull was calked and otherwise repaired, the engine repaired, and the boat salted, painted, and launched.

Steam-scow Neenah.—Unserviceable. The wheel was removed, the boat fitted out for a quarter-boat, and towed to Little Kaukauna Dam, for use of the employés on that work.

There were purchased and expended for repairs to boats, six bales of oakum, two barrels of pitch, five barrels of salt, 900 pounds of wrought spikes, 600 pounds of nails, 200 pounds of white-lead, 25 gallons of boiled oil, 10 pounds of lamp-black, 30 pounds of iron, 500 feet B. M. white-pine flooring, 9,000 feet B. M. of deck-plank, and 1,400 feet B. M. of white-oak timber.

Ninety-foot Scow.—The scow was hauled out, new oak rake-timbers were put in, and the rakes replanked. The sides, deck, and hatchways were repaired, and new grousers and cleats made. The whole boat was calked and pitched and the scow launched.

Sixty-foot scow.—The boat was hauled out. Repairs were made to the bottom, sides, and deck. The whole was calked and pitched, and the scow launched.

There were purchased and expended in repairs to scows 5,473 feet, B. M., of oak timber, 4,632 feet, B. M., of pine lumber, 588 pounds of iron, 750 pounds of spikes, 250 pounds of nails, 39 pounds of drift-bolts and washers, 23 pounds of screw-bolts and nuts, and 6 bales of oakum.

(9) SURVEYS.

Surveys were made of the point of land at the head of Neenah River and of its right bank near the Neenah Dam; also of the vicinity of the washout at the right end of the Rapid Croche Dam. Test-pits were dug at Menasha Dam to determine the location of the bed-rock.

MISCELLANEOUS.

Two large cribs were framed, placed, and filled with stone to mark the dredged channel in the upper end of Menasha River.

The steamer Henrietta and steam-launch General Meade were employed in transporting materials for works in progress and in towing dredges and dump-scows until navigation was suspended by ice, when they, together with Dredge No. 1, were laid up at Appleton. On the resumption of navigation the dredge and the steam-launch were put in commission, but the steamer Henrietta is still laid up.

The old crib-locks have required extensive repairs during the year, and will need the same from time to time until new ones are built. In replacing them I would respectfully suggest that they be constructed in the following order, viz: Appleton, third; Cedars, Little Kaukauna, Kaukauna, second; Kaukauna, fifth; De Pere, Appleton, fourth; Menasha and Little Chute, first. The old stone lock at Rapid Croche should have its walls increased 2 feet in height and 10 feet in length, to give it the capacity of the new locks.

In addition to building new locks, the following work is required to be done to complete the improvement of the Lower Fox River, viz: To construct a new dam with sluice-ways at Menasha; to replace the old lower dam at Appleton by a new one; to place sluice-ways in Cedars and Rapid Croche dams, and to complete the sluice-way in Little Kaukauna Dam; to deepen the canals and river channel to 6 feet at low water by dredging and by excavating through two rock-bars; to strengthen and pave the canal banks throughout the line, and to build dwellings for lock-tenders.

Respectfully submitted.

C. A. FULLER,
Assistant Engineer.

Capt. W. L. MARSHALL,
Corps of Engineers, U. S. A.

REPORT OF MR. J. W. ALLEN, JR., OVERSEER.

PORTAGE, WIS., *July* 14, 1885.

CAPTAIN: I have the honor to submit the following report of operations upon the improvement of the Upper Fox River for the fiscal year ending June 30, 1885:

IMPROVING THE FOX RIVER.

The operations of the year have been confined to watching the plant belonging to the improvement, which is stored principally at Portage, Berlin Lock, and Eureka Lock, and to keeping it in good condition. The repairs to the hulls of dredges and boats at Berlin Lock, which were in progress at the beginning of the year, were made during the fall of 1884, as follows:

Dredge No. 3.—Repairing and calking the sides and rakes was begun, but they were found to be in need of so extensive repairs below the water-line that work was stopped until the dredge could be hauled out. It will probably work the present season without having these repairs made. Slight repairs were made to the deck. Season checks in timber frame were filled, and the frame and hull were painted. Repairs to the sluice-scow of this dredge were in progress at the beginning of the year. It was found necessary to make these repairs more extensive than at first contemplated. The sides were cut down to the grub-stakes, and the scow above these entirely rebuilt and painted, the bottom recalked, and the scow launched.

Dredge No. 4.—Bearing piles for ways were driven; ways were laid, and this dredge hauled out and raised on blocking. Ten 1-inch rods were put in across the hull. The ends of eight floor-timbers were spliced with sound timber. The bottom and sides were repaired and calked. The deck was calked. The roof and hull were painted, and the dredge launched.

Dredge No. 6—The deck was repaired and calked. The hull hauled out, and one seam on each side below water calked. The cabin roof was repaired and painted. The two 70-foot pontons were out on blocking at the beginning of the year. The bottoms, sides, and decks were repaired and recalked, and both pontons launched.

Barge.—The barge was hauled out and raised on blocking. A new hog-rod was put in extending the whole length of the hull. New grouser frames were made. A 2-inch lining was put in all around the hull to stiffen it. The bottom, sides, and deck were recalked. The hull was painted and launched.

Pile-driver.—One of the stone scows from the Wisconsin River improvement was towed from Portage to Berlin Lock and hauled out. A new bulkhead, in addition to the two already in the scow, was put in, the scow recalked and launched. The machinery and leads of the pile-driver were repaired and loaded on the scow. A cabin was built over the engine. A new hammer line was purchased, and the driver, in good working order, was towed to Oshkosh, and transferred to the Lower Fox River.

OPERATING AND CARE OF CANALS AND OTHER WORKS OF NAVIGATION.

There was no interruption to navigation through the several locks during the season. Such repairs as were necessary were made. One dredge was put in commission and worked from July 5 to November 18, in removing bars and maintaining a good channel for navigation.

The following is a brief statement of the work done at the several localities:

PORTAGE LOCK AND CANAL.

A watchman was employed at this lock during the extreme high water in the Wisconsin River, but no work was required during the year.

FORT WINNEBAGO LOCK.

The hangings of the lower gates were repaired.

GOVERNOR BEND LOCK AND DAM.

Two tons of old hay were sunk with stone back of the lock walls to check, temporarily, the leakage. Oak for new hollow quoins, and gates, and the irons for new gates were purchased.

MONTELLO LOCK, DAM, AND LEVEE.

Gravel backing was put in back of both the abutments of the dam. Several low and weak places in the levee were raised. As the ice broke up in the spring the levee was watched and slight repairs made.

GRAND RIVER LOCK AND DAM.

Slight repairs were made to the lock and canal banks.

PRINCETON LOCK AND DAM.

Seventeen cords of stone and 115 cords of brush, made into mats, were transported to the dam and used in repairing a hole caused by the settlement of the brush and timber, and in protecting both the abutments.

WHITE RIVER LOCK AND DAM.

Slight repairs were made to the lock and canal bank. The bank above the dam was protected and the dam itself strengthened. Ninety-one cords of brush and 18 cords of stone were used in this work.

BERLIN LOCK, DAM, AND CANAL.

A break in the south canal bank 100 feet long, caused by the high water, was repaired. The canal banks at several places were protected. Eighty-eight cords of brush, 27 cords of stone, and 232 cubic yards of earth were used in this work. A new spar was put on one of the upper gates.

EUREKA LOCK AND DAM.

The toe-posts of the south gates of the lock were cut off just above water and spliced with sound timber.

DREDGING.

Dredge No. 5 was fitted out and began work raising and strengthening the Berlin Canal banks, building banks 1,557 feet long in the aggregate, and containing 6,678 cubic yards. The dredge was then towed up river and worked in the channel at twenty-three different bars between Montello and White River Lock, excavating 79,256 cubic yards; of this, 4,885 cubic yards were handled twice, leaving 74,371 cubic yards of material that were permanently disposed of.

The tug Boscobel was employed in towing and tending Dredge No. 5, in towing material for repairing dams and canal banks. The Boscobel was employed seventeen days on the Wisconsin River.

Very respectfully, your obedient servant,

J. W. ALLEN, JR.,
Overseer.

Capt. W. L. MARSHALL,
Corps of Engineers, U. S. A.

WISCONSIN RIVER.

REPORT OF MR. J. W. ALLEN, JR., OVERSEER.

PORTAGE, WIS., *July* 13, 1885.

CAPTAIN: I have the honor to submit the following report of operations upon the improvement of the Wisconsin River for the fiscal year ending June 30, 1885.

No work was done during the year toward completing the improvement, the funds available being insufficient to warrant it. The operations of the year were the care of the plant belonging to the improvement, keeping a record of water elevations, and some repairs to the works already constructed.

IMPROVING THE WISCONSIN RIVER.

The boats, scows and tools belonging to the work were stored at Portage in charge of a watchman during the year, except as they were needed for protecting existing work and for surveying purposes.

The upper works and decks of the steamers Winneconne and Dekorra were painted, as were also the roofs of quarter-boats No. 1 and No. 2. Records of the stage of water were kept at Portage during the year, and at Dekorra and Merrimack during the seven months that the river was free from ice.

Table showing the duration of different stages of water in the Wisconsin River at Portage, above or below General G. K. Warren's zero, 3 feet above the miter-sill for the year 1884.

Month.	Depth extreme low-water to zero.	Depth 0 to 1 foot.	Depth 1 to 2 feet.	Depth 2 to 3 feet.	Depth 3 to 4 feet.	Depth 4 to 5 feet.	Depth 5 to 6 feet.	Depth 6 to 7 feet.	Depth 7 to 8 feet.	Total number of days.	Extreme low water.	Extreme high water.
	Days.	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Feet.*	*Feet.*
March	......	......	18	4	3	5	1	......	......	31	......	......
April	......	......	......	......	7	15	8	......	......	30	......	......
May	......	......	......	14	17	......	......	......	......	31	......	......
June	......	......	11	17	2	......	......	......	......	30	......	......
July	3	17	9	2	......	......	......	......	......	31	−0.2	......
August	......	15	16	......	......	......	......	......	......	31	......	......
September	......	......	3	8	1	3	6	8	1	30	......	7.0
October	......	......	......	......	9	5	4	12	1	31	......	7.0
November	......	2	4	10	14	......	......	......	......	30	......	......
Total	3	34	61	55	53	28	19	20	2	275	......	......

NOTE.—The highest water on record is 7.3, which occurred June 17, 1880.

GAUGING.

Preparations were made and a party was organized for taking a series of observations for discharge of the river. Four gauging sections, at Portage, Dekorra, and two intermediate points, were staked out, and guages at each section were established. A sudden and unexpected rise in the river, beginning the last of August, just as the party was ready to commence taking observations, and amounting to 5 feet in fifteen days, interfered with this work and prevented satisfactory results being obtained. Reports from the head-waters and heavy rains indicating a long continuance of high water, the party was discharged. The river remained at too high a stage for gauging observations until it was closed by ice.

OPERATING AND CARE OF CANALS AND OTHER WORKS OF NAVIGATION.

Work of putting in good condition those of the wing-dams between Portage and Dekorra which needed repair was begun August 20. The dams, in general, were found in good condition, and a good navigable channel was maintained by them. A number of them had settled somewhat, and in two or three places the ice had done considerable damage.

Seven hundred and sixty-nine cords of brush were cut and made into fascines, 244 cords of stone were purchased, 240 cords of brush, and 40 cords of stone were used in repairing eight dams. The high water impeded the work on these dams early in September, and compelled the abandoment of all work of repairs September 13, though some of the brush was cut after that date.

The tug Boscobel was transferred from the Upper Fox River to the Wisconsin River, and worked seventeen days in towing material for the repairs to dams, and in assisting the gauging party. The steamer Winneconne was fitted out and employed in the same work a short time.

Very respectfully, your obedient servant,

J. W. ALLEN, JR.,
Overseer.

Capt. W. L. MARSHALL,
Corps of Engineers, U. S. A.

REPORT OF BOARD OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Milwaukee, Wis., September 17, 1884.

SIR: The Board of Engineers constituted by paragraph 1, Special Orders No. 98, headquarters Corps of Engineers, August 8, 1884, has the honor to submit the following report:

The Board is required to report: (1) What works should be constructed and what changes should be made in existing works to carry into effect the proviso attached to the item for improving Fox and Wisconsin rivers, Wisconsin, contained in the river and harbor act of August 2, 1882. (2) Also to report what lands and structures it will be necessary to purchase to carry into effect these recommendations in accordance with the proviso attached to the item for improving Fox and Wisconsin rivers, Wisconsin, contained in the river and harbor act of July 5, 1884. (3) To direct its attention to the navigation of the Fox, and state its recommendations of the depth required by commerce now or in the near future existing in the Upper Fox and in the Lower Fox, and also its recommendations upon the expediency of replacing the present wooden locks, in whole or in part, with stone.

The provisos attached to the river and harbor acts referred to are as follows:

ACT OF AUGUST 2, 1882.

Provided, That the Secretary of War shall, without delay, cause the channel of the Lower Fox River, between Lake Winnebago and the upper Government dam at Appleton, to be restored to its natural width and capacity, and shall cause such changes and alterations to be made in the dams at Menasha and Appleton, not inconsistent with security to navigation, as may be necessary to reduce to and maintain the waters of Lake Winnebago and Little Butte des Morts, respectively, at their natural height; and a sufficient amount of said sum appropriated is made immediately available.

ACT OF JULY 5, 1884.

Provided, That in order to carry into effect the river and harbor act of August second, eighteen hundred and eighty-two, for lowering the water in Lake Winnebago, the Secretary of War is hereby authorized to acquire for the United States by purchase, voluntary or by condemnation under the laws of Wisconsin, as the case may be, the necessary lands and sites at the Menasha Dam, and so much of the foregoing sum hereby appropriated as may be necessary may be used for such purpose.

The Board visited the Fox River and examined its navigation throughout and made special examination of the Neenah and Menasha outlets to Lake Winnebago and the constructions impeding the discharge of these outlets, and examined into the circumstances which probably induced the passage by Congress of the provisos quoted above. As these circumstances and facts relating to the proviso in the act of August 2, 1882, and the action of the Secretary of War in compliance therewith, are fully set forth in the papers submitted to the Board, viz, Senate Ex. Doc. No. 53, Forty-seventh Congress, first session, House Ex. Doc. No. 93, Forty-seventh Congress, first session, Senate Ex. Doc. No. 92, Forty-eighth Congress, first session, it is not considered necessary to recount them in detail herein further than is necessary to explain the recommendations made in this report. In the autumn of 1881 an extraordinary flood occurred in the streams emptying into Lake Winnebago, which raised the waters of the lake to an unusual or abnormal height, causing great damage to the cities of Fond du Lac and Oshkosh, and to the farming and other interests of the inhabitants dwelling along the shores of Lake Winnebago and of the Fox and Wolf rivers. The natural outlets of Lake Winnebago, the Menasha and the Neenah channels, were and are both obstructed by dams. The former channel was also narrowed by a causeway, and by mills projecting from the canal embankment into the channel, which contracted the width of this outlet from about 420 feet to about 182 feet. The effect of these dams and encroachments upon the channel was to increase the height of the flood, and to prolong the duration, and thus increase the damage to property subjected to the high water. To prevent the recurrence of such disaster, and at the same time to injure as little as possible the interests of navigation, seems to have been the object of the proviso attached to the act of 1882. Immediately after its passage a Board of Engineers was constituted to examine into the requirements of this proviso and to report what changes in the dams, &c., were necessary to comply with the act. The conclusions of this Board are stated in their reports contained in Senate Ex. Doc. No. 92, Forty-eighth Congress, first session, and, in effect, were:

(1) That the interests dependent upon the water-powers developed by the dams at Menasha, Neenah, and Appleton are too great to permit the channel of the Lower Fox River between Lake Winnebago and the upper Government dam at Appleton to be restored to its natural width and capacity, since this would necessitate the destruction of property of immense value that is in itself no injury to navigation.

(2) That to prevent a recurrence of similar high water in Lake Winnebago and Little Lake Butte des Morts, certain changes in the dams at Appleton, Menasha, and Neenah were necessary; *i. e.*, that the dams should either be lowered or that ample sluices should be placed therein to discharge the surplus water and lower the head of water on the dams at floods. The changes recommended in the Appleton Dam, which in-

volved the construction of ample sluices, were completed. The Neenah Dam is private property, and in this dam sluices have been placed by the owners. At Menasha the dam was lowered 18 inches for a length of 182 feet in 1882, and flush-boards of the same height, removable at high stages, were placed thereon; but when work began at removing the embankment at the right of the dam to lengthen the spill, it was stopped by an injunction from the circuit court of Winnebago County, Wisconsin, on the application of Alexander Syme and Mary Syme, who claimed that their property would be injured thereby by the backing up of the water in the tail-races of their mills, due to the overfall from the dam.

The suit is still pending and the injunction is still in force. The mills that it is claimed will be damaged by any further changes in the Menasha Dam, are situated immediately in rear of the present dam, founded in whole or part within the channel-way, but on submerged land owned or claimed by Syme, and are not obstructions to navigation. The matter of altering the Menasha Dam, to give an increased discharge to the Menasha Channel at high stages, being in this condition, and there being no money available for compensating the owners for injury to private property, Congress at its last session attached the proviso quoted above to the river and harbor act approved July 5, 1884.

The Board of Engineers consider it evidently the intention of Congress, in passing these provisos, that the dam at Menasha shall be so lengthened and modified as to allow, as near as practicable, the natural or full discharge of this channel at high water, to prevent the recurrence of floods similar to that of 1881, and that it has appropriated money to extinguish any conflicting private rights and claims.

It is considered by the Board that the interests of the manufacturing establishments at Menasha and Neenah, dependent upon the water-powers at the outlets of Lake Winnebago, are such that they will not allow, without compensation, any diminution of their available water-power during ordinary stages of water. Nor will the present condition of navigation permit any lowering of the dams at the outlets of Lake Winnebago. The Board therefore recommend, in addition to the work already done, that the dam at Menasha be rebuilt just below the site of the present dam, across the full width of the Menasha Channel; of the same height as the present dam, with flush-boards, and that at least four sluice-ways 20 feet wide each and 7 feet deep, closed by gates of the same kind as at Appleton, be placed in the dam near the left bank of the river; and that when the new lock is built at the lower end of the canal, the present site of the old lock be used for additional sluices to be opened at high water. These modifications at Menasha will give a fixed weir or "spill" 316 feet in length instead of 182 feet, and, in addition, sluices having a total width of 80 feet and a depth of 7 feet. The sluices at the end of the canal will still further increase the sluice capacity. The dam as recommended will be 420 feet between abutments instead of 182 feet, as at present.

At Neenah it is considered that the present dam and sluice-ways, being private property, cannot be modified by the United States. The length of weir and sluices seem sufficient in the present condition of the channel; but, to increase the discharge through this channel and over the dam, which is lower than the Menasha Dam, the Board recommend that the Neenah Channel be enlarged by dredging off the point on the left bank, at the entrance, about 400 feet, and that the point on the right bank, just above the Neenah Dam, be dredged and the channel widened about 50 feet. At present the Neenah outlet is choked at the entrance, which prevents the full capacity of the lower channel, as modified by the Neenah Dam, from being attained. A fixed weir with sluice-ways is recommended for the Menasha Dam instead of a movable crest, because the sluices can be more easily maneuvered and the level of Lake Winnebago more certainly controlled than by the use of flush-boards. The latter arrangement requires for facile use a bridge over the dam, and the boards are exposed to destruction by ice and drift.

It is understood that it is the intent of the act of 1882 that the relative levels of Lake Winnebago and Little Lake Butte des Morts shall be so maintained as to interfere with water-powers and private rights at Menasha, Neenah, and Appleton to the least degree consistent with the interests bordering Lake Winnebago and those of navigation. This object can be more certainly fulfilled by sluices in the dams at Menasha and Appleton to be worked in conjunction than by the use of movable crests.

The above-named works, in addition to that already done at Appleton, are considered sufficient to meet the requirements of the act of August 2, 1882, as far as relief from flood waters is in question.

To carry out the above recommendations, the following lands and structures thereon must be purchased:

(1) Lots 1, 2, 3, town of Menasha.

(2) The City or Eagle Mill.

(3) The Coral mill-site and mill at the middle of the proposed dam.

(4) The land at the point at the left bank at entrance to the Neenah outlet.

(5) The point (50 feet wide) above the right abutment of the Neenah Dam.

The recommendation for the widening of the Neenah Channel is intended simply to indicate that an additional amount of water can be discharged, if required, through this channel without further alterations in that dam, or without constructing additional sluice-ways.

The Neenah Dam is lower than the Menasha Dam, and of greater length, but the entrance to that channel is contracted, so that the full benefit of this larger and lower weir is not now attained. Dredging, as indicated, will remedy this defect.

With reference to the navigation of the Fox and the requirements thereof, the Board have to report that at present there is 3 feet available depth of navigation in the Upper Fox from Portage to Princeton, 4 feet from Princeton to Oshkosh, 4½ feet at Menasha, and 5 feet thence to Green Bay. At present there is one regular boat between Portage and Berlin, three from Berlin to Oshkosh, and seven from Oshkosh to various points on the Fox and tributaries. Besides the regular boats, a number of tugs and transient boats navigate the lower river and lake Winnebago. Below Berlin the freight business is already large and will greatly increase as soon as continuous navigation can be assured. Even in its present uncertain condition the Fox River is of great value in regulating freight rates by rail to all points reached by it, and it is the opinion of the Board that the navigation is worthy of maintenance and improvement. The freights carried consist mainly of coal, salt, lumber, stone, lime, and other building material and manufactured articles. The continual failure of the old structures necessitate frequent suspensions of navigation for repairs, and the resulting uncertainty in the minds of those desiring to put boats in the Fox River trade has acted to retard the development of river traffic, which can only be remedied by a completion of the improvement in a permanent manner.

After considering the present and the probable amount of commerce of the river, the following recommendations are respectfully made:

(1) That from Portage to Montello a depth of 4 feet of water at low water be maintained, and that the old wooden locks, four in number, be thoroughly repaired and preserved for the present.

(2) That the channel between Montello and Lake Winnebago be deepened by dredging to 6 feet and widened to 100 feet.

(3) That the channel of the Lower Fox be deepened by dredging and rock excavation to 6 feet throughout, and that the old wooden lift-locks, eight in number, be replaced as rapidly as practicable by permanent works of stone; also, that the old timber lock at Little Chute be repaired and used as a guard-lock.

It is the opinion of the Board that on account of the faulty construction of the old locks they cannot be economically repaired and maintained when of considerable lift, and that the navigation of the Lower Fox is of sufficient value and importance to justify the construction of permanent works, without reference to the project for a through route of transportation from the Mississippi River to the great Lakes.

A plan and sections of the proposed dam and sluice-way at Menasha and a map of Neenah Channel, showing limits of proposed dredging, are herewith.

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers.
WM. E. MERRILL,
Lieut. Col. of Engineers.
J. W. BARLOW,
Lieut. Col. of Engineers.
W. L. MARSHALL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 8, 1884.

SIR: The river and harbor act of July 5, 1884, contains the following:

> Improving Fox and Wisconsin rivers, Wisconsin: Continuing improvement, one hundred and sixty thousand dollars, of which sum ten thousand dollars are to be used for maintaining the channel between Depere and Green Bay: *Provided*, That in order to carry into effect the river and harbor act of August second, one thousand eight hundred and eighty-two, for lowering the water in Lake Winnebago, the Secretary of War is hereby authorized to acquire for the United States by purchase, voluntary or by condemnation under the laws of Wisconsin, as the case may be, the necessary lands and sites at the Menasha Dam; and so much of the foregoing sum hereby appropriated as may be necessary may be used for such purpose.

With the sanction of the Secretary of War a Board of Engineer officers was constituted to consider and report as to what works should be constructed and what changes should be made in existing works to carry into effect the proviso attached to the item for improving Fox and Wisconsin rivers, Wisconsin, contained in the river and harbor act of August 2, 1882; and also to report what lands and structures it will be necessary to purchase in order to carry out these recommendations in accordance with the proviso attached to the item for improving Fox and

Wisconsin rivers, Wisconsin, contained in the river and harbor act of July 5, 1884, above quoted.

In connection with the subject of improving the rivers referred to, and in view of the improbability of the original project for making a through line of cheap transportation by way of the Fox and Wisconsin rivers from the Mississippi River to the lakes being carried out, the Board was directed to consider that question, and also give its attention to the navigation of the Fox River, and submit recommendations as to the depth required by commerce now, or in the near future, existing in the Upper Fox and in the Lower Fox, and also its recommendations upon the expediency of replacing the present wooden locks in whole or in part by stone structures.

The Board, acting upon the foregoing instructions, has presented a report, which is herewith respectfully submitted. The full and careful consideration it has given the subject add great weight to its conclusions, which seem to me to be just and proper, and in which I concur.

I have accordingly to recommend that steps be at once undertaken for acquiring, "by purchase, voluntary or by condemnation under the laws of Wisconsin, as the case may be, the necessary lands and sites at the Menasha Dam," as provided for in the river and harbor act of July 5, 1884, as follows:

(1) Lots 1, 2, 3, town of Menasha.

(2) The City or Eagle Mill.

(3) The Coral mill-site and mill at the middle of the proposed dam.

(4) The land at the point at the left bank at entrance to the Neenah outlet.

(5) The point (50 feet wide) above the right abutment of the Neenah Dam—these lands and sites being necessary to the carrying out of the recommendations of the Board.

There being, however, no estimate submitted as to the cost of the lands and sites, it is suggested that no money be expended upon the work recommended by the Board until the cost has been ascertained. In connection with this subject attention is invited to the letter of the Hon. Philetus Sawyer, United States Senator, and to the memorandum of mill-owners inclosed therein, agreeing that they will not in any manner interfere with the work of widening the Menasha Dam, &c., accompanying the report of the Board.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers, Brig. and Bvt. Maj. Gen.

HON. ROBERT T. LINCOLN.
Secretary of War.

[First indorsement.]

The recommendation of the Chief of Engineers is approved.
By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT, *December* 10, 1884.

APPENDIX J J.

IMPROVEMENT OF THE HARBORS OF CHICAGO AND CALUMET, ILLINOIS—IMPROVEMENT OF ILLINOIS AND CALUMET RIVERS—SURVEYS FOR HENNEPIN CANAL, AND FOR THE ENLARGEMENT OF THE ILLINOIS AND MICHIGAN CANAL.

REPORT OF MAJOR W. H. H. BENYAURD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Chicago Harbor, Illinois.
2. Calumet Harbor, Illinois.
3. Illinois River.
4. Calumet River.

EXAMINATIONS AND SURVEYS.

5. For Hennepin Canal, and for the enlargement of the Illinois and Michigan Canal.
6. Wolf Lake, Indiana.
7. For ship-canal from Calumet River to Lake Calumet, Illinois.
8. Calumet River, Illinois, from a point half a mile east of Hammond to the forks of the river.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., July 27, 1885.

GENERAL: I have the honor to transmit herewith annual reports for the works under my charge for the fiscal year ending June 30, 1885. These works were temporarily under the charge of Maj. Thomas H. Handbury during my absence on sick leave from December 19, 1884, to June 30, 1885.

Very respectfully, your obedient servant,

W. H. H. BENYAURD,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

J J 1.

IMPROVEMENT OF HARBOR AT CHICAGO, ILLINOIS.

The project of improvement now in course of execution at this harbor was adopted in 1870, and modified in 1878. The objects sought are, first, the formation of an outer harbor adjoining the entrance to the Chicago River, and designed, also, to furnish increased commercial facilities by relieving the river from its overcrowded condition; second, the creation of a harbor of refuge affording a good anchorage in deep water and safe access to the outer harbor and river.

EXTERIOR BREAKWATER.

The first crib for this work was sunk in position in July, 1881, and at the end of the fiscal year ending June 30, 1884, 3,236 linear feet of cribwork had been sunk in position and the superstructure built to various heights over the entire structure. For a space of 2,336 feet the superstructure was built to the required height: over 500 feet, to a height of four courses; over 200 feet, to a height of three courses, and over the remainder, to a height of two courses. During the past year the following amount of work was accomplished:

Seven cribs, each 100 feet long, were completed and sunk on the easterly end of the breakwater. One of these cribs was made to take the place of Crib No. 9, destroyed by the storm of October 4, 1881.

Four cribs were commenced and built to various heights, and retained in the outer harbor ready for operation the following season.

The superstructure on the westerly end was built to its intended height, thus completing that portion of the work.

The superstructure was built over six other cribs to a height of four courses above the water. Crib 39, damaged by the storm of November 17, 1884, was repaired and refitted with stone. Extensive repairs were made to Crib No. 6, cut down to a depth of 10 feet below the water on June 7, 1884, by steam-barge Milwaukee, and other repairs were made to different parts of the work, due to the damage caused by collisions of vessels.

In addition a large portion of the work was refilled with stone to make up the loss during the preceding winter.

Advertisements inviting proposals for about 2,167,000 feet B. M. timber for breakwater construction were published November 8, 1884, and opened December 9, 1884, and contracts awarded as follows:

Chauncey E. Mitchell, hemlock timber for eight cribs, at $10.44 per thousand feet.

Leatham & Smith, pine timber for eight cribs, at $12.50 per thousand feet.

Five thousand six hundred and sixty-six and ninety-two hundredths cords of stone were purchased under an agreement with the Bodenschatz Earnshaw Stone Company, dated August 1, 1884, at a price of $4.93 per cord.

Mr. George C. Almy, assistant engineer, was in local charge of the exterior breakwater.

After the completion of the westerly section of the breakwater last season, work was again started on the easterly extension which had been interrupted by the partial destruction by storm of Crib No. 9. Crib 34, which was built and sunk upon the old foundation of No. 9, differed from the other cribs in construction only by the omission of the foundation courses, the stone filling of the old crib being used as the new foundation. Cribs 33, 35, 36, 37, and 38 were also finished and sunk in position. These cribs were built, sunk, and filled as all the other cribs of the work had been, though the depth of water was somewhat greater on the easterly than on the westerly section.

On the 8th of October a violent northeast storm prevailed, and all the cribs as above, except No. 34, were more or less settled, and their general alignment greatly disarranged by the careening of the cribs as they settled. The stone in these cribs, which before the storm was level with their tops, had settled to the depth of several feet. With the view of bringing their tops above the water-surface, work was continued upon the settled cribs as long as the weather would permit, but at the close of the season they were more or less under water. Crib 39 was sunk afterwards, and, profiting by the experience of the other work, several additional courses were added to this crib in order to bring the top above water level should another storm occur.

On the 17th of November a northeast gale with heavy sea occurred, and upon its subsidence it was found that this crib had acted like the thers, in settling and careening. Under these gales and heavy seas crib No. 34, which had been sunk upon the stone foundation, retained its stability and correct level. The action of these cribs under a severe storm suggests a modification in the construction of the foundation of he remaining cribs for the work with a view of obtaining greater stability and less liability to damage from the action of heavy seas. The subject is now under consideration, and as no work will be done this season the matter will be fully worked up and laid before the Department for further action. The original height of the structure above the water-level was fixed at 8 feet. It is found, however, that it has gradu lly settled about 2 feet, and therefore the work will require two addi ional courses throughout its entire length.

DREDGING IN OUTER HARBOR.

The present project contemplates dredging the outer harbor to a depth f 16 feet, the westerly limit of dredging being the dock-line established y the Board of Engineers convened by Special Order 168, Chief of Engineers, August 3, 1871, the area included being about 270 acres, he original depth of which varied from 10 to 19 feet. The remainder f the sheltered area will be reserved for piers and slips, and comprises 185 acres, making the total lake area included within the limits of the outer harbor 455 acres. The contract with the Green Bay Dredge and Pile Driver Company, entered into June 21, 1883, was completed, and another contract entered into September 15, 1884, with the Chicago Dredging and Dock Company, for dredging 21,000 cubic yards, in accordance with advertisements inviting proposals, dated July 26, 1884, and opened September 2, 1884. The price per cubic yard was 23½ cents. Work was commenced at once and the contract completed October 7, 1884. The amount of material yet to be removed is about 267,000 cubic yards.

PROPOSED APPLICATION OF FUNDS AVAILABLE.

The amount available July 1, 1885, after deducting outstanding liabilities, was $4,423.38, and will be reserved for the care of public property and such repairs as can be done with the limited means.

ESTIMATE FOR THE YEAR ENDING JUNE 30, 1887.

For the purpose of continuing the work on the exterior breakwater and dredging in the outer harbor the sum of $225,000 is asked.

Money statement.

July 1, 1884, amount available		$7,104 69
Amount appropriated by act approved July 5, 1884		100,000 00
December 4, 1884, received on account of judgment, schooner Two Fannies		77 76
		107,182 45
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$79,127 07	
July 1, 1885, outstanding liabilities	23,632 00	
		102,759 07
July 1, 1885, amount available		4,423 38

Amount (estimated) required for completion of existing project	$284,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	225,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened September 2, 1884, for dredging Chicago Harbor, Illinois.

Names of bidders.	Price per cubic yard.	Remarks.
	Cents.	
Green Bay Dredge and Pile Driver Company	24¼	
Dodge & Petrie	24	
Fitz, Simons & Connell	24	
Chicago Dredging and Dock Company	*23¼	Lowest bidder.

*Contract awarded.

Abstract of proposals received and opened December 9, 1884, for furnishing 2,167,000 feet B. M. timber for breakwater construction at Chicago, Ill.

Names of bidders.	Pine timber per 1,000 feet B. M.	Hemlock timber per 1,000 feet B. M.	Number of cribs bid for.		Remarks.
			Pine.	Hemlock.	
A. S. Packard	$14 50	$10 50	8	8	
Leatham & Smith	*12 50	10 50	8	8	Omitted to sign individual names.
Chauncey E. Mitchell	13 94	*10 44	8	8	
Ripley & Son		11 45		8	Proposal not dated.
W. E. Hutchinson	15 40	11 00	8	2	
Lyman & De Prinier	15 75	12 75	8	8	
George Hannahs	10 75	13 00	4	4	Failing contractor.
Petrie Lumber Company	14 95	10 74	5	5	Guarantee not dated.
T. R. Lyon, by Elijah H. Hubbard, attorney	15 50		8		Informal.
Charles B. Cromby & Co	14 95	13 95	8	8	Do.

*Awarded.

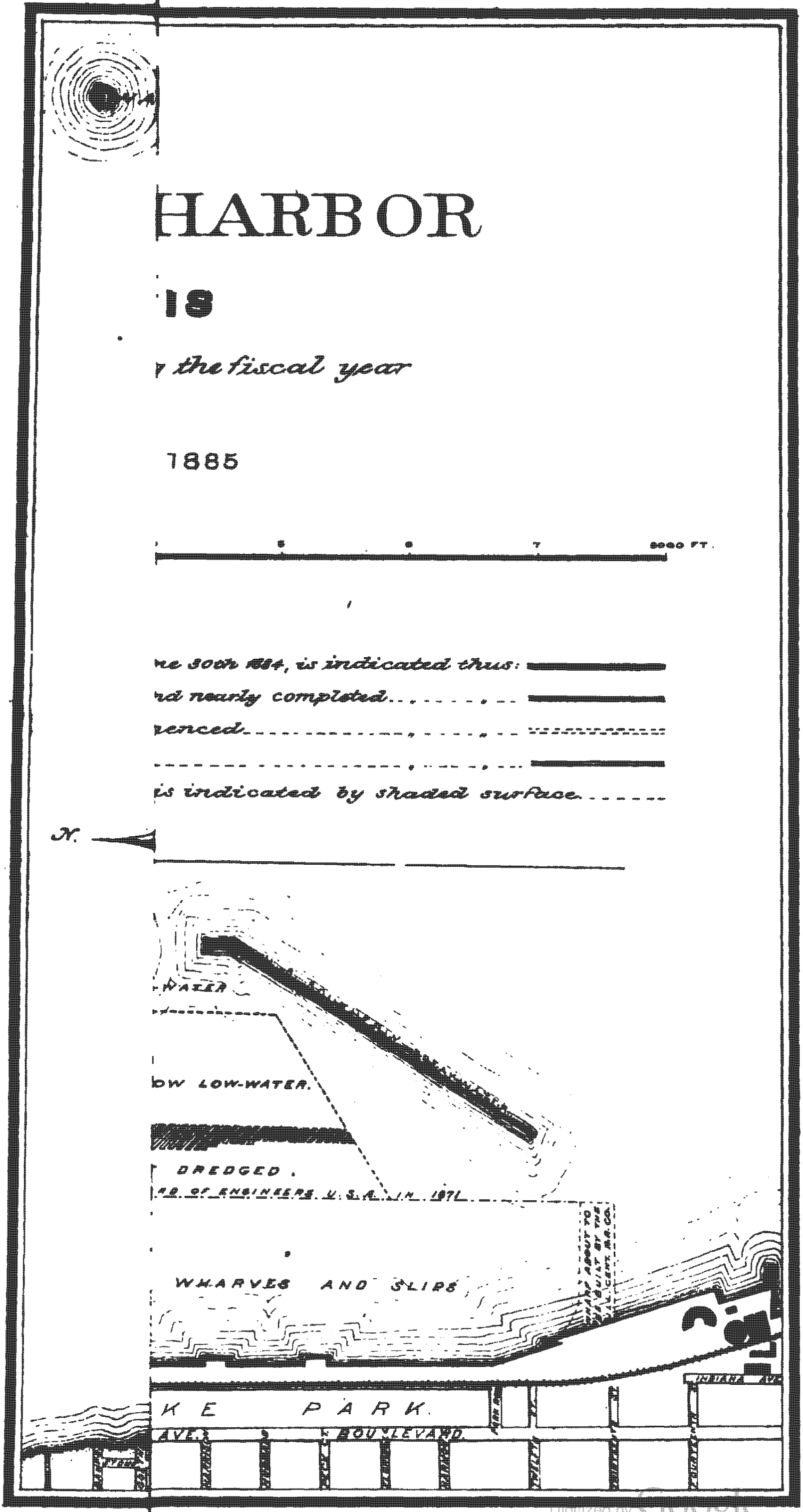
Abstract of contracts for Chicago Harbor, Illinois, in force during the fiscal year ending June 30, 1885.

Contractors.	For—	Date.	Expires—	Remarks.
Green Bay Dredge and Pile-Driver Company.	Dredging	June 21, 1883	September 4, 1884	Completed.
Chicago Dredging and Dock Company.	do	September 15, 1884	Close of season of navigation, 1884.	Do.
Chauncey E. Mitchell	Timber	December 26, 1884	September 1, 1885	
Leatham & Smith	do	January 2, 1885	September 1, 1885	

COMMERCIAL STATISTICS.

Chicago is a port of entry in the collection district of Chicago. There is a light-house on the shore end and a beacon-light on the lake end of the north pier. There is also a beacon-light on the south end of the easterly breakwater.

Number of vessels entered during the fiscal year	9,653
Number of vessels cleared during the fiscal year	9,759
Total tonnage of vessels entered and cleared	6,617,277
Amount of revenue collected	$4,163,531 72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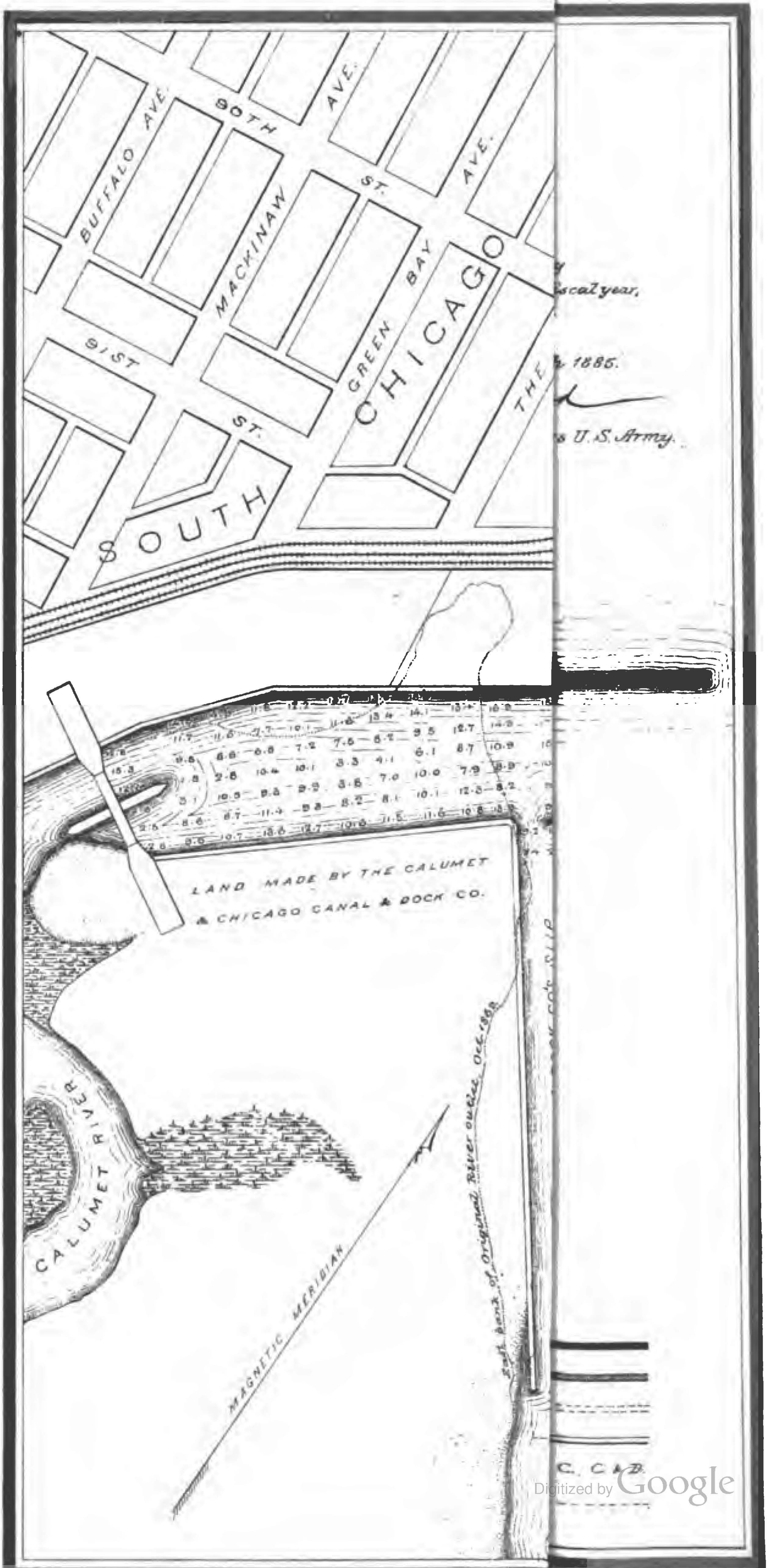
90TH ST.
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THE
LAND MADE BY THE CALUMET & CHICAGO CANAL & DOCK CO.
CALUMET RIVER
MAGNETIC MERIDIAN
East bank of Original River outlet Oct. 1869
scal year,
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C. C & D.

J J 2.

IMPROVEMENT OF HARBOR AT CALUMET, ILLINOIS.

The object of this improvement is to provide a safe and reliable entrance to the Calumet River and part of South Chicago. It is proposed to accomplish this by the construction of two parallel piers 300 feet apart, projecting from the shore to deep water in the lake, and by dredging the channel-way between them to a depth sufficient to accommodate the largest class of vessels seeking the port. This work was commenced in 1870, and at the close of the fiscal year ending June 30, 1885, 3,640 linear feet of the north pier and 1,720 feet of the south pier had been completed, making a total length of pier-work of 5,360 feet. The total amount of material dredged from the harbor from the beginning of operations in 1870 to the present time is 384,376 cubic yards. Advertisements inviting proposals for extending the south pier 200 linear feet were published July 24, 1884, and opened August 30, 1884, and the contract was awarded to the Calumet and Chicago Canal and Dock Company. Work was commenced about September 30, 1884, and completed November 25, 1884.

The old plank revetment built at the inception of the work was found to be in bad condition. The work of repair thereon was commenced in August and finished in September, during which period a length of 748 feet was put in thorough order.

CONDITION OF THE WORK JUNE 30, 1885.

With the exception of the oldest portion of the work, built some twelve or fourteen years ago, the piers are in fair condition.

The slag from the North Chicago Rolling Mills still continues to be dumped along the shore in the immediate vicinity of the north pier. The shore line has advanced a further distance of 72 feet during the past year, due almost entirely, it is believed, to this cause. A report upon the advance of the shore from the commencement of the work to the end of the last fiscal year was transmitted to Congress and printed in House Ex. Doc. No. 36, Forty-eighth Congress, second session, but no action was taken thereon. The continuation of the filling up of the lake in the immediate vicinity of our work cannot help but cause a shoaling up at the end of the pier, and will call for a further extension of the work to maintain the depth of 16 feet demanded at the entrance of the harbor.

Amount available July 1, 1885, is $1,225.59, and will be used in the preservation of the work and in taking care of public property.

ESTIMATE OF FUNDS FOR YEAR ENDING JUNE 30, 1887.

It is intended to extend the south pier a further distance of 300 feet, to repair a portion of the old plank revetment, and to refill a portion of crib-work with stone.

These operations will complete the present project, the estimate for which is $21,400.

The dredging previously estimated for will not be required until the pier extension as above provided for is carried out and the effects of the work in cutting off the drift of sand into the harbor is ascertained.

Amount appropriated from commencement of work to June 30, 1885.....	$382,000 00
Amount expended to June 30, 1885..................................	380,774 41

The only contract in force during the fiscal year ending June 30, 1885, was that of the Calumet and Chicago Canal and Dock Company, for extending the south pier 200 feet, which was completed November 25, 1884.

Money statement.

July 1, 1884, amount available	$245 61
Amount appropriated by act approved July 5, 1884	20,000 00
	20,245 61
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	19,020 02
July 1, 1885, amount available	1,225 59
Amount (estimated) required for completion of existing project	21,400 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	21,400 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The harbor of Calumet is at South Chicago, in the collection district of Chicago. There is a light-house and a keeper's dwelling on the reservation, near the shore end of the north pier. A beacon light is maintained at the extremity of that pier to mark the entrance to the harbor.

Number of vessels entered during the fiscal year	316
Number of vessels cleared during the fiscal year	319
Total tonnage of vessels entered and cleared	311,385

J J 3.

IMPROVEMENT OF ILLINOIS RIVER, ILLINOIS.

The project now in course of execution for the improvement of this river contemplates the construction of a lock and dam at each of the sites selected, viz, La Grange and Kampsville, and the dredging of the channel from the State lock at Copperas Creek to the mouth of the river.

PROGRESS DURING THE YEAR.

As the funds available at the commencement of the fiscal year for the improvement of the river would not admit of operations being carried on at both lock sites, the working force, with the necessary plant, was concentrated at the La Grange Lock. Mr. R. A. Brown, assistant engineer, was in charge of the local improvements. Work was commenced early in July in pumping and clearing out the coffer-dam preparatory to resuming stone-setting on the lock-walls. This latter work was commenced July 23 and continued to December, when cold weather put an end to operations for the season. The work was delayed and interfered with at times owing to the non-delivery of certain necessary stone that the contractors should have had upon the ground. We were occasionally obliged to borrow stone from one wall to advance the work upon the other. The work upon the foundation of the east dam abutment was commenced in August and finished the following month. The stone-work was then commenced and the entire abutment completed in November.

The following is a summary of the work executed and the amount of material used during the season:

	Cubic yards.
Cut stone, dressed face	2,080.08
Cut stone, quarry face	1,413.90
Squared stone	4,069.10
Backing stone	4,069.10
Special stone	824.98
East dam abutment	299.00

The average cost of the stone-setting per cubic yard, including sand, cement, and labor, was $2.02.

In addition to the above work several cribs of the dam foundation were finished inside the coffer-dam. While this work was going on upon the lock-walls, the plant was overhauled and put in condition for future operations.

All the stone necessary for the completion of the lock-walls will be upon the ground at the end of the present month.

Kampsville Lock.—No work was done at this point. A contract was entered into November 8, 1884, with Messrs. Sanger & Moody, of Joliet, Ill., for furnishing—

	Cubic yards.
Cut stone, dressed face	432
Cut stone, quarry face	365
Special stone	265

PROPOSED APPLICATION OF FUNDS AVAILABLE.

The amount available June 30, 1885, exclusive of outstanding liabilities was $18,592.74. This will be applied to finishing the lock-walls at La Grange and the care and preservation of the plant and work.

ESTIMATE FOR THE YEAR ENDING JUNE 30, 1887.

In the original project for the improvement of the Illinois River by locks and dams it was especially recommended that the appropriations should be sufficiently ample to keep a full working force employed throughout the working season, as in that manner only could steady progress be made in the work of construction, and the funds could be applied thereto instead of taking a considerable portion thereof to guard against the damage to which unfinished works are subjected during the period of suspension, as well as using more than would otherwise be needed for the repair and preservation of the plant and material. It was expected that ample funds would be provided to carry on the work at both lock-sites. Unfortunately this has not been done, and the best interests of the work are suffering thereby. The Kampsville lock foundation has been finished now nearly two seasons, and no additional work has been done at that place since. The coffer-dam has been flooded and left to itself. To again prepare for a resumption of work will only be at considerable additional expense, which otherwise could have been avoided by timely appropriation. In like manner we have been at considerable expense in protecting from injury the lock-walls, temporary work, plant, and material at La Grange, during the long suspension of operations, and these expenses will necessarily increase as this period lengthens.

From the experience gained during the progress of the work I have found it advisable to make certain necessary additions to the locks at both places for the better security and preservation of the work. The works are located at points inaccessible to ordinary travel, and the labor and material have to be taken to the localities at additional expense.

For these various reasons I have revised the estimates for the completion of the project, as follows:

To complete La Grange Lock	$50,000
To complete Kampsville Lock	290,000
To build Kampsville Dam	78,000
To build La Grange Dam	52,000
To which amount should be added the estimated cost of dredging and wing-dams	270,000
Total	740,000
Deduct available funds and material contracted for	40,000
Balance required to complete project	700,000

Money statement.

July 1, 1884, amount available		$6,135 14
Amount appropriated by act approved July 5, 1884		100,000 00
		106,135 14
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$63,992 64	
July 1, 1885, outstanding liabilities	23,549 76	
		87,542 40
July 1, 1885, amount available		18,592 74

Amount (estimated) required for completion of existing project	700,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	350,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of contracts for Illinois River in force during the fiscal year ending June 30, 1885.

Contractors.	For—	Date.	Expires.	Remarks.
Sanger & Moody	Stone	August 29, 1883	August 1, 1885	
Do.	do	November 8, 1884	June 30, 1885	Extended to October 1, 1885.

COMMERCIAL STATISTICS.

Illinois River is in the customs district of New Orleans.

	Tons.
Freight shipped from Saint Louis, Mo., via Illinois River	3,710
Freight received at Saint Louis, Mo., via Illinois River	110,955

	Number.
Boats arrived at Saint Louis, Mo., from the Illinois River	170
Boats departed from Saint Louis, Mo., for the Illinois River	189

The amount of commerce in the statement affords no adequate measure of the importance of the improvement. The State has constructed two locks and dams, situated respectively at Copperas Creek and Henry. This work, supplemented by the enlargement of the Illinois and Michigan Canal, as now proposed, will afford a reliable and commodious water communication from the lake to the Mississippi River.

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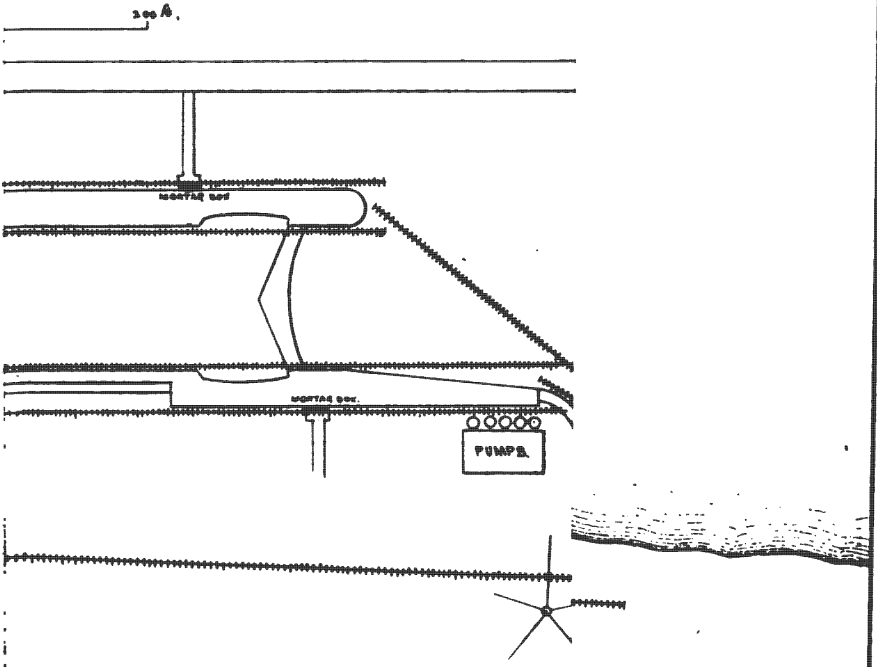

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U.S. Army

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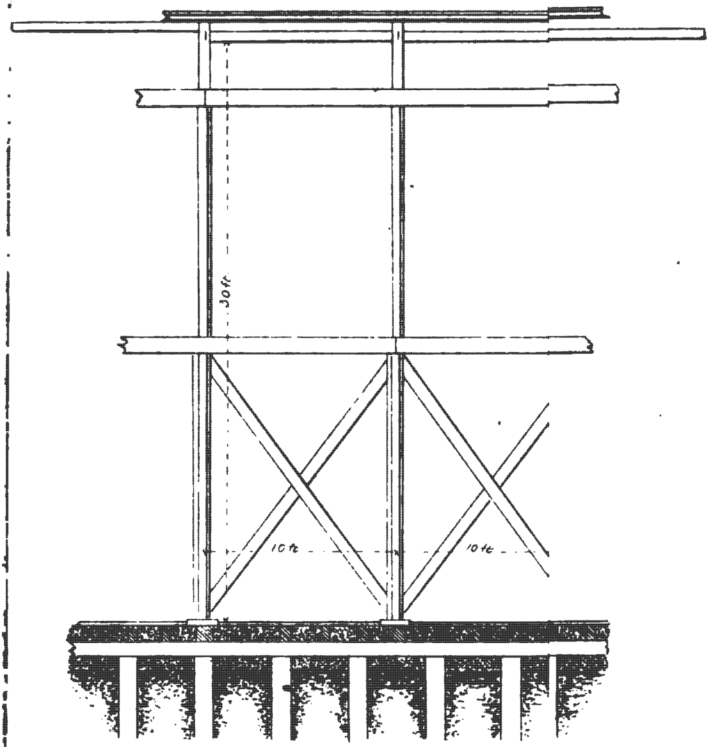
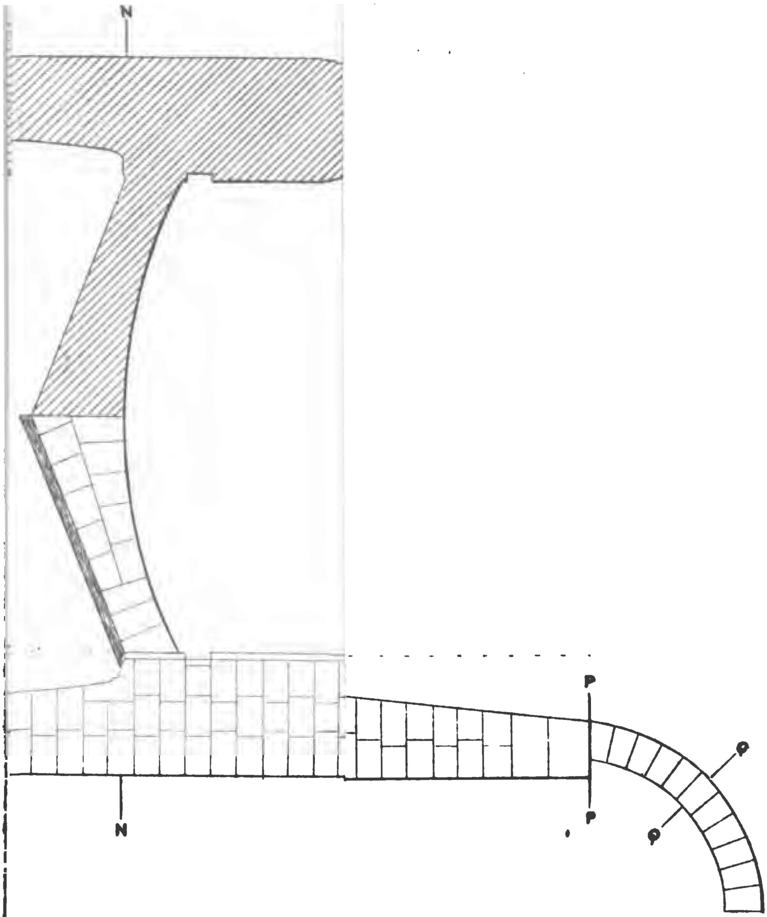


D.

Annual Report for 1885.

f Engineers U.S. Army.



Freight received and shipped via Illinois and Michigan Canal at Chicago, Illinois.

Articles.		Receipts.	Shipments.
Flour	barrels	89,466	180
Corn-meal	pounds	23,600	....
Wheat	bushels	7,559	910,122
Corn	do	1,157,247	3,174
Oats	do	693,895	54,724
Rye	do	40,775	2,558
Seeds	pounds	122,118	2,700
Coal	tons	1,291	....
Brick	number	4,155,736	2,237,940
Stone	cubic yards	337,794	....
Clay (fire)	tons	15,255	....
Sand	do	1,005	....
Ice	do	82,405	....
Machinery	pounds	5,000	21,300
Not enumerated	do	627,867	1,000,248
Drain pipe	do	28,000	....
Iron of all kinds	do	28,000	191,616
Lumber	feet	22,000	31,044,141
Gravel	cubic yards	11,590	....
Carpenter and joiner work	pounds	....	46,515
Furniture	do	....	250
Flooring (dressed)	feet	....	26,240
Lath	number	....	6,033,374
Lime (common)	barrels	....	460
Lime (hydraulic)	do	....	228
Merchandise	pounds	....	177,200
Nails and spikes	do	....	19,650
Oils	barrels	....	76
Posts and rails	number	....	46,050
Railroad ties	do	....	4,390
Shingles	do	....	15,238,970
Salt	barrels	....	1,040
Staves and headings	number	....	7,000
Sidings	feet	....	112,349
Wagons	pounds	....	14,050

J J 4.

IMPROVEMENT OF CALUMET RIVER, ILLINOIS.

The sum of $50,000 was appropriated by the river and harbor act approved July 5, 1884, for the improvement of this river, with the following provision inserted:

> That no part of said sum shall be expended until the right of way shall have been conveyed to the United States, free from expense, and the United States shall be fully released from all liability for damages to adjacent property-owners to the satisfaction of the Secretary of War.

At the present time releases have been obtained from the property-owners on the lower section of the river as high up as One Hundred and Sixth street. As yet but few property-owners above that point have signified their assent to the proposition. No work will be done until all have signed the necessary releases to the satisfaction of the Secretary of War. Should this be done in season an additional appropriation of $100,000 will be needed to purchase a plant and carry on the work, as recommended by the Board of Engineer Officers.

Money statement.

Amount appropriated by act approved July 5, 1884	$50,000 00
July 1, 1885, amount available	50,000 00
Amount (estimated) required for completion of existing project	175,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	100,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

J J 5.

SURVEYS FOR THE HENNEPIN CANAL AND THE ENLARGEMENT OF THE ILLINOIS AND MICHIGAN CANAL.

Some necessary work was done upon the maps of the survey, which were unfinished at the time the reports were rendered.

Money statement.

July 1, 1884, amount available	$9,010 92
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	739 41
July 1, 1885, amount available	8,271 51

J J 6.

PRELIMINARY EXAMINATION OF WOLF LAKE, INDIANA.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., August 30, 1884.

GENERAL: I have the honor to present the following report upon the preliminary examination of Wolf Lake, Indiana, required by the act of Congress approved July 5, 1884. As the improvement of this lake in itself would be of no importance except a connection be made with Lake Michigan, it is presumed that those interested in the matter intended to include in the proposed survey the short branch known as Wolf River, and through which an outlet could be made into Lake Michigan, as shown on the inclosed tracing.

The question of the improvement of Wolf Lake, the connection with Lake Michigan, and the formation of a harbor of refuge outside, has been the subject of investigation at various times, and full reports thereon have been rendered the Department. Colonel Houston examined the matter and reported upon it in November, 1873. Major Gillespie made a detailed survey of the lake and its surroundings in 1874; the report thereon will be found in the Report of the Chief of Engineers for that year, page 241. Major Lydecker reported upon the "resurvey of outlet to Wolf Lake" in 1880. (See Chief of Engineers' Report for 1880, page 1999.)

Major Gillespie, after describing the locality and giving the details of the survey, states:

> As far as relates to harbor facilities for the commerce and trade of the country bordering on the southern end of Lake Michigan, the harbor at Michigan City, the very fine harbor at Calumet, and the harbor at Chicago meet every present demand. The private parties owning land bordering on the lakes mentioned above propose the deepening of Wolf River and the making of a cut through the beach at its outlet to Lake Michigan for the purpose of developing their lands and making them available for manufacturing and industrial purposes. An easy communication with Lake Michigan through Wolf River, with piers at its outlet, forming a safe and commodious harbor, with not less than 14 feet of water, is the object sought in their request for Government aid, and in their memorial it is expressly stipulated that the aid of the Government is only asked in the work extending from the water-line of the lake into Lake Michigan, and that the private parties and associates will themselves complete and entirely execute all work south of the water-line of Lake Michigan.
>
> As the exceedingly fine harbor at Calumet, made within the last four years at a cost to the Government of a little over $200,000, is only 3 miles to the westward of the proposed improvement at the mouth of Wolf River, and as the lands on Wolf

Lake can be made accessible at no great expense by way of Calumet Harbor, Calumet River, and the several lake connections, it is questionable if the Government can be called upon with propriety to expend anything at present upon this new work.

Major Lydecker reports:

> The site for the contemplated work is between Michigan City and Calumet harbors, being 32 miles west of the former and 2¼ miles southeast of the latter. A harbor of refuge is *not* needed there. No factories or other industrial establishments had been erected, and there is no local commerce; no opportunity for any in the present condition of affairs. The interests centered there can hardly be regarded in any other light than as speculative at this writing, or, as stated by Colonel Houston in 1873, "its value will depend on developments of the future." It may be stated, however, that this is a fair site for a harbor; a capacious interior basin can easily be made, and at comparatively small expense, by dredging the several interconnecting lakes in the vicinity. It is probable that advantage will be taken of this condition of affairs in due time, and that the expectations of those owning the property or otherwise interested will be realized. The necessity for dredging a channel to deep water in the lake and constructing protecting piers might then become evident.

I have examined the locality, and find no reason to differ from the opinions of the officers above quoted. The situation remains the same as at the date of the last report, with the possible exception that two large ice-houses have been erected upon the borders of the lake. No other industrial pursuits have been entered into.

I do not, therefore, regard the locality as one worthy of improvement by the Government at the present time.

Very respectfully, your obedient servant,

W. H. H. BENYAURD,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

J J 7.

PRELIMINARY EXAMINATION FOR SHIP-CANAL FROM CALUMET RIVER TO LAKE CALUMET, ILLINOIS.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., September 10, 1884.

GENERAL: I have the honor to present the following preliminary report upon the proposed ship-canal from Calumet River to Calumet Lake, Illinois, as provided for in the river and harbor act of July 5, 1884.

As shown on the inclosed tracing, it is proposed to start the canal at Cummings, on the Calumet River, and carry it a distance of about 7,000 feet to Lake Calumet, directly opposite the town of Pullman.

As near as can be ascertained, the idea of digging a canal or ditch at the site indicated was first projected in the fall of 1874. It was claimed that a channel of some dimensions was needed for sanitary purposes, and for the purpose of preventing the overflow of the surrounding country. The site was selected as being through land that was not, at that time, subdivided, and clear titles thereto could be obtained without difficulty.

No work was done, however, but the land was put on record "as reserved for a ship-canal."

On the 16th of April, 1880, an ordinance was passed by the board of trustees of Hyde Park—

> To dredge a ditch from Brown's Mill (now called Cummings) Slip to Lake Calumet on a line 428 feet north of and parallel with One hundred and tenth street, the bottom of said ditch to be 25 feet wide, with a uniform depth of 9 feet below the coping of Brown's Dock, the sides to slope at an inclination of 2 feet horizontally to 1 foot vertically.

In pursuance of this ordinance, assessments were made and put in the hands of collectors, the list being known as "Assessment No. 97 of Hyde Park." This ordinance was repealed in the summer of 1883.

The ditch, formerly proposed for drainage purposes, has now grown to the dimensions of a ship-canal. Major Lydecker, in his report of January 7, 1882, upon "the survey of the Calumet River, from South Chicago to the village of Pullman, on Lake Calumet," in addition to following the main river to the forks near Lake Calumet, and thence to Pullman, estimated also upon the shorter course by way of the canal as above proposed. He states:

> The estimated amount of dredging for a channel 100 feet wide, with a low-water depth of 15 feet, from Calumet Harbor to the entrance to Lake Calumet, is, in round numbers, 725,000 cubic yards; thence through the lake to the village of Pullman, 525,000 cubic yards. Total, 1,250,000 cubic yards. A shorter and more direct line to Pullman would be to leave the river at Brown's Mill (Irondale), and make a direct cut in continuation of the slip indicated on the maps that are transmitted herewith. The total excavation by this route will be 850,000 cubic yards, of which, however, only 250,000 cubic yards will be in the river. The distance to Pullman by the first route is 9½ miles; by the latter, 5¼ miles.
>
> But the operations by the Government should be confined to the river in a way to benefit all interests, and not only a single enterprise; access by the river to property adjoining Hyde and Wolf lakes, as well as to Calumet, is needed, and it seems quite clear that our operations should have in view the construction of a main trunk line, from which special channels may be made in any direction by the parties interested in developing each particular locality.

Congress, by the act of July 5, 1884, appropriated $50,000 for the improvement of the Calumet River, from the harbor to the forks near Lake Calumet, and there is a possibility that the work will hereafter be continued as far as Hammond.

This will give the adjacent property-owners a good channel through which they can gain an outlet to the lake; any work beyond this should be done by those interested and not by the Government.

The proposed enterprise connects the Calumet River, which will have a channel depth of 16 feet, with Lake Calumet, in which the water in the deepest part is not over 6 feet.

To be utilized in any manner suitable for lake vessels, Calumet Lake must also be dredged to a depth of 16 feet; this is not proposed in the bill, but no doubt the Government would be called upon to carry it out.

The proposed work amounts, really, in fact, to the extension of Brown's Slip through the country to Lake Calumet.

While the Calumet region is fast developing into a manufacturing and industrial district, and many new enterprises are calculated to be entered into at an early date, I cannot see that the commercial value of the proposed canal at the present time puts it upon a basis sufficient to warrant its being deemed worthy of improvement by the Government.

Very respectfully, your obedient servant,

W. H. H. BENYAURD,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

J J 8.

PRELIMINARY EXAMINATION OF CALUMET RIVER, ILLINOIS, FROM A POINT HALF A MILE EAST OF HAMMOND TO THE FORKS OF THE RIVER.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., September 10, 1884.

GENERAL: I have the honor to present the following report upon the preliminary examination of "the Calumet River from half a mile east of Hammond, Ind., to the forks of the river," as provided for in the river and harbor act approved July 5, 1884.

The stretch of river above referred to is a part of the Grand Calumet, which was examined and reported upon by me in September, 1882, in accordance with the provisions of the river and harbor act of August 2 of that year. In that report I stated that while I did not consider the improvement of both branches an urgent public necessity I did consider the upper river, within certain limits, worthy of improvement, taken in consideration with the improvement of the lower river and harbor as then contemplated. Since the date of that report a Board of Engineer officers has reported favorably upon the improvement of the Calumet as high up as the forks near Lake Calumet, and Congress has made an appropriation of $50,000 with which to commence work.

The present survey ordered contemplates a further extension of this work to the town of Hammond, a distance of about 4 miles. Taking into consideration the constantly increasing importance of the Calumet region as a manufacturing and shipping point, and the impetus that will be given to the different interests commercially by the improvements now in contemplation, I deem the river worthy of improvement to the point indicated near Hammond. The estimated cost of the survey, including office work, preparation of maps, &c., is $500.

Very respectfully, your obedient servant,

W. H. H. BENYAURD,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

SURVEY OF CALUMET RIVER, ILLINOIS, FROM A POINT HALF A MILE EAST OF HAMMOND TO THE FORKS OF THE RIVER.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., March 27, 1885.

GENERAL: To comply with your letter of November 21, 1884, I have the honor to submit the following project, with estimate of the cost, of improvement proper to be made in the case of the "Calumet River, from a point half a mile east of Hammond to the forks of the river."

This project, which is called for by the river and harbor act of July 5, 1884, is an extension of one already submitted by the Board of Engineers authorized by the river and harbor act of August 2, 1882. The report of this Board may be found in that of the Chief of Engineers for 1883, page 1748. To commence the improvement recommended by this Board, Congress, in the river and harbor act of July 5, 1884, appropriated the sum of $50,000, "provided, however, that no part of said sum shall be expended until the right of way shall have been conveyed to the United States, free from expense, and the United States shall be fully released from all liability for damages to adjacent property owners, to the satisfaction of the Secretary of War."

The recommendations of the Board contemplate that the channel to be improved and controlled by the Government be in general 200 feet in width, and that the boundaries of the channel be established as a dock line to limit any construction by private parties or corporations. The depth to be attained over the 200 feet width is at least 16 feet. These recommendations cover that portion of the Calumet River between Lake Michigan and the forks of the river near Lake Calumet, a distance of 6½ miles. The project now under consideration extends 5 miles farther, to a point one-half mile east of Hammond, making the total distance from Lake Michigan 11½ miles. About 1¾ miles above the outlet of Lake Calumet the Little Calumet joins Calumet River. It is said that at one time the Little Calumet, instead of flowing as it now does from this point west, flowed east and emptied into Lake Michigan about 15 miles beyond Hammond. All indications point to this as being correct. The old mouth is now permanently banked up with sand, and the distance back to the junction is but a long, narrow lake, with low, marshy borders. In fact throughout its whole reach the Calumet River lies in a marsh. Occasionally there are spots higher than others which are the nuclei around which are rapidly being developed those interests and industries which call for the improvement of the river. Throughout the reach under consideration the river will average perhaps a little more than 100 feet in width, and vessels drawing 7 feet can pass up as far as Hammond. The average mid-channel depth is about 9 feet. In that portion above the mouth of Little Calumet the bottom is composed of mud resting upon sand, which in its turn overlies the clay stratum. Below this junction the current is sufficient to carry the mud away. No special borings have been made, but dredging in different localities indicate that clay may be found at an average depth of about 10 feet below the water surface.

From the mouth of the Calumet River to the old mouth of Little Calumet the distance is about 26 miles. At a very moderate expense this can be made into a wide and deep canal that will furnish easy communication with Lake Michigan from the various slips and docks along its border that the necessities of commerce may from time to time cause to be made, and so with all the dockage that may be made along the borders of Calumet, Wolf, and George lakes.

There are twelve main lines of railroads running east and south from Chicago, all located in the vicinity of Calumet River. A large amount of the commerce transported over these is transshipped at Chicago either to or from vessels plying upon Lake Michigan. At the Chicago River where this change is effected the necessities of the traffic are fast outgrowing the accommodations which that stream affords. That the advantages offered by the region of the Calumet River for transshipment of the lake commerce will soon be utilized is evident from the fact that a large amount of capital is being invested in this locality looking to this end. There is no doubt but in the course of a very few years the importance of this river as a point for transshipment will be equal to that of Chicago River. The benefit to be derived from the improvement that it is proposed the Government shall effect will be of that general character which results from an increase in the facilities for handling the commerce of the country. Locally it will increase the value of property and thus add to the general revenues.

In preparing the project for the improvement of that part of the river between the fork at the outlet of Lake Calumet and a point one-half mile east of Hammond, I have simply extended over this reach the project already approved for that portion of the river below. This project contemplates widening the river to 200 feet, and deepening it by dredging to 16 feet. The earth thus dredged should be deposited upon the adjoining lands.

The excavation that will be required to accomplish this, throughout the 5 miles under consideration, will be approzimately 2,500,000 cubic yards. To make the channel but 100 feet wide and 16 feet deep for the same distance 1,000,000 cubic yards will be required.

The figure at which this work could be contracted for, judging from the rates now prevalent in this locality, would not be less than 15 cents per cubic yard, which would make the cost of excavating 2,500,000 cubic yards $375.000.

Should it be decided, as is recommended by the Board of Engineers that submitted the project for the improvement of the lower part of the river, that the Government purchase its own machinery and do the work by hired labor, the estimate would be about as follows:

For purchase of dredging outfit	$75,000
Excavating 2,500,000 cubic yards, at 5 cents	125,000
Total	200,000

This estimate is contingent upon the fact that sufficient funds are appropriated at the outset for the purchase of the necessary plant and the performance of one season's work, which should be $100,000.

It would probably be for the best interest of navigation to first make the channel 100 feet wide throughout the whole distance, afterward extending it to 200. After the plant is provided this would require $50,000 and probably two seasons' work with one machine.

It would not be necessary to do any work upon this reach of the river until that upon the lower was well advanced towards completion.

Accompanying this report I transmit that of my assistant, G. A. M. Liljencrantz, which gives more detailed information concerning this locality; also a tracing from a map of the river prepared by him. On this are laid down the limits of the channel 200 feet wide. As these lie wholly upon ground belonging to private or corporate individuals, in order to avoid legal complications it would be necessary to have their consent, or a condemnation of their property before the Government could commence this improvement.

As this property in particular will be benefited by the proposed improvement, it is suggested that no part of the work be commenced "until the right of way shall have been conveyed to the United States, free from expense, and the United States shall be fully released from all liability for damages to adjacent property owners, to the satisfaction of the Secretary of War."

Very respectfully, your obedient servant,

THOS. H. HANDBURY,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. G. A. M. LILJENCRANTZ, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., February 27, 1885.

MAJOR: I have the honor to report that, in conformity with your orders, I have made a survey of "Calumet River from a point half a mile east of Hammond to the forks of the river," the report of which is hereby respectfully submitted.

* * * * * * *

The river and harbor act approved July 5, 1884, ordered a survey to be made of "Calumet River from a point half a mile east of Hammond to the forks of the river." It has been assumed that the latter expression had reference to the fork at the channel leading to Lake Calumet (though the junction of Grand and Little Calumet rivers at Hegewisch is in that locality commonly called the forks of the river), as that place was the terminus of the survey of the lower part of Calumet River in 1881.

The lately surveyed portion of the river may be divided into two principal parts, viz: The lower (A) from the fork at Lake Calumet to the junction of the Grand and Little Calumet rivers, and the upper (B) from this point to a point half a mile east of Hammond.

Almost the whole distance of the former runs through a wide marsh covered with a thick growth of reeds. It is claimed by old settlers that this channel was not originally a part of Calumet River, but that many years ago the Grand and Little Calumet rivers formed one stream with its outlet into Lake Michigan at a place where now is the head of the Grand Calumet; and that this part (A) was first formed by the Indians, who, with their trading canoes, here made a connection with Lake Calumet and the lower river. This originally insignificant channel was in subsequent years gradually scoured out to its present dimensions by the current, which at times is quite strong from the Little Calumet. Partly through the influence of this altered course of the current, and partly through the effect of northerly seas, the original mouth of the Grand Calumet became closed, and the lower Calumet River has since, many years back, formed a common outlet at the present Calumet Harbor for the two river branches.

The upper portion (B) is also bordered by marsh along the greater part of its length, though in many places here it consists only of comparatively narrow strips; whereever land is found it is very low and generally so very slowly and irregularly rising in elevation as to make it impossible at any time to decide upon any definite shoreline. This difficulty was furthermore increased by another circumstance explained hereafter.

The method of making the survey on the ice had several advantages, such as saving of time and consequently of expense, and making easily accessible a locality which is extremely inconvenient, and therefore more expensive to survey in the summertime, and, finally, facilitating the absolutely correct location of the soundings and contours of the river channel. There were some disadvantages as well; the shallow soundings, especially those at the edge of the marsh where the water was more or less mixed with mud before freezing, could not be determined very closely, and the shoreline, which, as stated before, is very hard to define at any time, is infinitely more so when such low and frozen ground is covered by 10 to 20 inches of snow, which was the case when this survey was made.

The first work done was to run careful levels from a bench-mark in Pullman, via Hammond, to convenient places along the river, where bench-marks were established, by means of which the elevation of the ice above the zero of the United States harbor gauge was ascertained. The Grand Calumet has no tributaries and any fluctuation in the water level in this branch must be caused, outside of possible springs, by the rise or fall of the lower river. The difference in elevation of the ice at the extreme ends of the territory now surveyed was only fifteen-hundredths of a foot. No consideration has been given to this nominal slope, three-hundredths of a foot to the mile, in reducing the soundings to the plane of reference, which is the zero of the United States harbor gauge, and which is one foot above the Chicago City datum.

To verify the work and form one complete system, connection was made with bench-marks on the lower part of the river and with the harbor gauge at South Chicago. This work was done by Mr. William Lee, and with very good results as shown by duplicate levels.

Soundings were taken 20 feet apart on lines across the river about every 100 feet, and each end of these lines was located by means of transit instrument and stadia rod. The soundings, which on the map have been referred to the zero of United States harbor gauge, show an average depth of the deep-water channel for the whole distance of about 8.9 feet, and indicate that the bottom consists of sand over a substratum of clay and covered by a layer of soft mud for the whole distance of the Grand Calumet. Below the junction with the Little Calumet the strong current from this branch keeps the deep-water channel free from the soft mud. No borings were made to ascertain the exact depths of mud and sand to clay, but dredging, in that locality have shown clay to be generally found at a depth of about 10 feet below the plane of reference.

The projected system of soundings was interfered with in three places where the ice had been and was at the time being cut and removed to adjacent ice-houses, which made these places inaccessible to the sounding party, and they were accordingly passed by. The comparatively slight variations in the cross-sections of the river justify the assertion that this omission will not have any noticeable effect on the estimate of the required dredging.

To give a general idea of the character of the different portions of the river, a table has been prepared and is appended, showing the average depth of the deep-water channel, the average width of the river, and the dredging required for each half mile, also the average for the whole distance of the several items respectively, and finally the total amount of dredging which must be done to secure the projected channel.

Subdivision.	Average depth.	Average width.	Dredging required.	Remarks.
	Feet.	*Feet.*	*Cubic yards*	
First half-mile	8.6	150	245,598	Near Lake Calumet.
Second half-mile	9.7	110	248,158	
Third half-mile	10.1	100	241,354	Reaching Hegewisch.
Fourth half-mile	9.4	125	247,099	
Fifth half-mile	8.4	120	268,902	
Sixth half-mile	7.8	160	263,498	
Seventh half-mile	8.0	170	256,011	
Eighth half-mile	8.7	180	249,482	
Ninth half-mile	8.9	150	242,878	Reaching Hammond.
Tenth half-mile	9.8	195	232,188	
Averages	8.94	146	249,466.8	For each half-mile.
Total	....	....	2,494,668	For 5 miles.

The table shows that in round numbers 2,500,000 cubic yards of material must be removed to secure a channel 200 feet wide and 16 feet deep at low water. As a matter of course, an exact estimate cannot be made until the dock lines are established, and possible changes in the channel decided upon. The amount here presented is a very close approximation for the present course of the channel.

One million eight thousand two hundred and seventy-six cubic yards of dredging would give a channel of the same depth, but only 100 feet wide.

As just stated, these estimates allude to the enlargement of the present course of the river. It may, however, be desirable to straighten it in one or more places. This operation is strongly suggested in one instance just east of Hegewisch by the peculiar relative position of a slough through which a very advantageous "cut-off" may be made if a connection is extended through the adjoining, now inaccessible, marsh. This would shorten the river channel about 1,100 feet, and this without encroaching in the least on valuable land. To call attention to this circumstance the outlines of the said slough with some characteristic soundings were ascertained, and are shown on the map. The 5 miles of the Calumet River just surveyed have not as yet been as extensively improved or occupied by enterprising corporations as the lower part of the river. Outside of a few ice-houses, there are at present only two localities improved to any extent, viz: Hegewisch, Illinois, and Hammond, Illinois and Indiana.

Hegewisch is situated at the junction of the Grand and Little Calumet rivers. Its existence dates back something less than a year, and is wholly due to the location at this place of the United States Rolling Stock Company, after whose president it is named. In this short time about one hundred buildings have been erected, counting in those in the subdivisions and including two hotels, one of which will accommodate sixty people; stores of various kinds and dwellings, besides the company's work-shops. About five hundred persons have become permanent inhabitants. The United States Rolling Stock Company is a corporation of extraordinary dimensions. It was organized in New York in 1871, with a cash capital of $5,000,000 paid in full. The shops were later located in Urbana, Ohio, and with the increase in business, additional shops were built in Chicago. To consolidate the works in these places, and greatly increase the producing capacity, the grounds at Hegewisch were selected. The company purchased here 100 acres of land, with over 2,000 feet frontage on Calumet River, and a number of large buildings have been erected for work-shops, &c. Several of these are already finished, but all are expected to be ready for occupancy not later than May 1, of the present year.

The shops will have an estimated capacity of thirty cars per day, and will furnish employment for more than two thousand persons. The estimated cost of the works completed is $750,000.

It is expected to bring all raw material, wood, iron, and coal from the lake via the Calumet River.

Three subdivisions have been made in the immediate vicinity, and more than $130,000 have been realized from the sale of lots within the last nine months. It is believed that before the end of the year 1885 the population of this place will have increased to at least 5,000.

Statistics pertaining to the United States Rolling Stock Company were kindly furnished by Mr. O. B. Calton, the principal assistant engineer.

Hammond is a small village located on the Grand Calumet River, and on both sides of the Illinois and Indiana State line. It has about 4,000 inhabitants, of which, according to the census of April, 1884, 2,856 were on the Indiana side. Outside of a slaughter-house and a few ice-houses there are no enterprises of importance, according to statistics furnished at the request of the writer by persons most interested in this place. The general business of the village is represented by the following figures furnished by M. M. Towle:

Freight received in one month	tons	325,106
Freights outgoing in one month	do	243,983
Total		569,089

Three railroad bridges and one wagon-road bridge cross the river at the village. They are all swing-bridges, the former being substantial iron structures, though furnishing only a 45-foot channel at the narrowest part of the draw; the latter is an old wooden bridge of a very inferior construction.

The only docks that have been built up to date are one at Hegewisch 500 feet in length, and one at Hammond just west of the wagon-bridge; the latter dock is 390 feet long.

No bridges cross the river except the four at Hammond already mentioned.

A tracing of the map, showing the results of the survey, is herewith respectfully submitted.

I am, major, very respectfully, your obedient servant,

G. A. M. LILJENCRANTZ,
Assistant Engineer.

Maj. THOS. H. HANBURY,
Corps of Engineers, U. S. A.

APPENDIX K K.

IMPROVEMENT OF HARBORS ON THE EASTERN SHORE OF LAKE MICHIGAN AND OF GRAND RIVER BELOW GRAND RAPIDS.

REPORT OF CAPTAIN D. W. LOCKWOOD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Charlevoix Harbor, Michigan.
2. Frankfort Harbor, Michigan.
3. Harbor of refuge at Portage Lake, Michigan.
4. Manistee Harbor, Michigan.
5. Ludington Harbor, Michigan.
6. Pentwater Harbor, Michigan.
7. White River Harbor, Michigan.
8. Muskegon Harbor, Michigan.
9. Grand Haven Harbor, Michigan.
10. Grand River, Michigan.
11. Black Lake Harbor, Michigan.
12. Saugatuck Harbor, Michigan.
13. South Haven Harbor, Michigan.
14. Saint Joseph Harbor, Michigan.
15. New Buffalo Harbor, Michigan.
16. Michigan City Harbor, Indiana.

EXAMINATIONS AND SURVEYS.

17. Plan and estimate of cost of a harbor of refuge at Ludington, Michigan.
18. Little Traverse Bay, Michigan, near the village of Petoskey, with a view to constructing a harbor of refuge.

UNITED STATES ENGINEER OFFICE,
Grand Rapids, Mich., July 25, 1885.

GENERAL: I have the honor to submit herewith my annual reports for the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

K K 1.

IMPROVEMENT OF CHARLEVOIX HARBOR AND ENTRANCE TO PINE LAKE, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—There was a depth of 12 feet from Lake Michigan to Pine Lake, through the intermediate channels. The old piers and revetments are about the same as last year at this time.

During the past season the following work has been done: A section of the plank-beam revetment, covering 161 feet at inner end of lower channel, south side, near Round Lake, was repaired, new piles being driven to replace those that had been torn out by collision, and new cap-timbers put on where needed. A rock-elm wale piece was also added to the old work. At the shore end of south pier the plank-beam revetment, for a distance of 75 feet, was changed to close piling, secured by a timber superstructure and waling to the old work. The channel face of the inner crib of this pier was built up to a height of 6 feet.

Brush to the amount of 210 cords and 67.4 cords of stone were used in backing the plank-beam revetment where most needed. The work above mentioned was done in the fall of 1884.

Work so far this year (1885) has been confined to the upper channel, where a pile revetment has been built on both sides of the channel, commencing at Round Lake, and extending towards Pine Lake to the upper limit of the high banks. This revetment is 10 feet wide over all, and its length as follows: North bank, 339 feet; south bank, 366 feet. The width of channel is 82½ feet, which is as much as could be secured without extensive dredging. The effect of revetting the upper channel will be to prevent the tendency to shoaling in Round Lake at its eastern end, which has resulted from the cutting away of material in the high banks at the lower end of the channel. All the work at this harbor during the past fiscal year has been done under contract with Mr. Luther E. Allen, of Charlevoix, Mich.

In order to secure a depth of 12 feet at the harbor entrance, the south pier should be extended 300 feet; this is all the more important at the present time, as there are indications of a shoal forming in advance of the end of the south pier and a little to the south of it.

The plank-beam revetment between the piers and Round Lake will in a few years require a complete overhauling. This work has never been backed or tied back in any way, and as a result of this in places it shows a tendency to fall in towards the channel.

It is estimated that $50,000 can be profitably expended during the fiscal year ending June 30, 1887, in extending the south pier as already indicated, in completing the pile revetment in upper channel and in general repairs to piers and plank-beam revetments, and it is respectfully recommended that this amount be appropriated.

This work is located in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, Mich. The nearest light-house is Grand Traverse.

Original estimated cost of work, 1868	$198,044 14
Amended in 1876	186,000 00
Whole amount appropriated from 1868 to 1885, inclusive	71,000 00
Whole amount expended	66,207 10

Money statement.

July 1, 1884, amount available		$1,031 37
Amount appropriated by act approved July 5, 1884		10,000 00
		11,031 37
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,003 58	
July 1, 1885, outstanding liabilities	3,224 89	
		6,228 47
July 1, 1885, amount available		4,802 90
Amount (estimated) required for completion of existing project		115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887.		50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened September 29, 1884, *by Capt. D. W. Lockwood, Corps of Engineers, for improving harbor at Charlevoix, Mich. (repairing break in plank-beam revetment.)*

Material.	Luther E. Allen,* Charlevoix, Mich.	Carkin, Stickney & Cram, East Saginaw, Mich.
Piles, in place .... per linear foot..	$0 18	$0 19½
Pine timber, in place .... per M. feet, B. M..	29 00	30 00
Hardwood timber, in place .... do....	35 00	45 00
Screw and washer bolts, in place .... per pound..	07	06½
Drift-bolts, in place .... do....	04	04½
Wrought spike, in place .... do....	07	04½
Stone, in place .... per cord..	7 00	7 00
Brush, in place .... do....	8 50	5 50
Edgings, in place .... do....	3 50	5 50
Totals	2,825 51	4,057 07

* Award recommended.

Abstract of proposals received and opened September 29, 1884, *by Capt. D. W. Lockwood, Corps of Engineers, for improving harbor at Charlevoix, Mich. (building pile revetment, upper channel.)*

Material.	Luther E. Allen,* Charlevoix, Mich.	Carkin, Stickney & Cram, East Saginaw, Mich.
Piles, in place .... per linear foot..	$0 18	$0 19½
Pine timber, in place .... per M feet, B. M..	25 00	30 00
Hardwood timber, in place .... do....	28 00	45 00
Screw and washer bolts, in place .... per pound..	07	06½
Drift bolts, in place .... do....	04	04½
Wrought spike, in place .... do....	07	04½
Stone, in place .... per cord..	6 00	7 00
Brush, in place .... do....	8 00	5 50
Edgings, in place .... do....	3 00	5 50
Total	3,915 68	5,185 68

* Award recommended.

Contract with Luther E. Allen, dated October 18, 1884, repairing break in the plank beam revetment, expiring November 30, 1884 (extended to July 1, 1885). Building pile revetment, upper channel, expiring June 30, 1885 (extended to August 31, 1885).

STATEMENT OF COMMERCIAL STATISTICS, CHARLEVOIX HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	599
Revenue collected	$779 53

K K 2.

IMPROVEMENT OF FRANKFORT HARBOR, MICHIGAN.

The improvement at this harbor consists of a dredged channel 200 feet wide, connecting Lake Aux Becs Scies with Lake Michigan and protected on both sides by parallel revetments and piers extending into Lake Michigan.

The north pier, with revetment, is 998 feet long, and extends into Lake Michigan beyond the shore-line about 400 feet.

The south pier, with revetment, is 1,287 feet long, and extends into Lake Michigan beyond the shore-line 987 feet.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—Vessels drawing 12½ feet enter and leave the harbor without difficulty.

The crib-work is all in an effective condition, requiring only some additional ballast.

During the year the revetments, to wit, 337 feet on north side of channel and 187 feet on south side were entirely rebuilt from the water up, the work being done by hired labor and purchased material. The plan followed was to cut off the piles on a level with the upper edge of the wale streak, and on this foundation a new superstructure was constructed of 12-inch pine timber, four courses high on the channel face and three on the land side. The cross-ties were placed 12 feet apart. The filling of edgings ballasted with stone was carried up to the under side of the lower set of ties.

The balance of funds remaining on hand it is proposed to retain to meet contingencies, such as repairs necessitated by accidental collisions with the piers, or dredging should it become necessary from shoaling between the piers.

The lake bottom in advance of the piers at a depth of about 16 feet is rocky, and it is believed that should the piers be extended across the outer bar to this depth, there would be no further trouble from bar formations outside, as there can be no movement of sand along the shore beyond the line between the sandy and rocky bottom, at least until the shore-line has made out much beyond its present location.

It is with this object in view that additional appropriations for pier extension are recommended.

It is estimated that $50,000 can be profitably expended during the fiscal year ending June 30, 1887, in pier extension and necessary repairs, and it is respectfully recommended that this amount be appropriated.

The work is located in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, Mich. The nearest light-house is at Point Aux Becs Scies. A pier light is located near end of south pier.

Original estimated cost of work, 1866, amended in 1875, and again in 1879.	$254,196 00
Whole amount appropriated from 1865 to 1886, inclusive	248,659 85
Amount covered into the Treasury 1871 (Report 1871, page 133)	5,721 50
Whole amount expended	238,283 98

Money statement.

July 1, 1884, amount available	$2,647 30
Amount appropriated by act approved July 5, 1884	5,000 00
	7,647 30
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,992 93
July 1, 1885, amount available	4,654 37

Amount (estimated) required for completion of existing project	$80,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

STATEMENT OF COMMERCIAL STATISTICS, FRANKFORT HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	261
Revenue collected	$75 66

K K 3.

IMPROVEMENT OF HARBOR OF REFUGE AT PORTAGE LAKE, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water, 12 feet, from Portage Lake to Lake Michigan. The piers and revetments were in fair condition.

This improvement when completed is to afford a channel of entrance to Portage Lake 370 feet wide with an available depth of 18 feet. At present the work is only fairly begun. On the north side the channel has been revetted and the revetment extended into Lake Michigan beyond the shore-line 525 feet to about the normal 10-foot curve. On the south side the pile and edging revetment extends into Lake Michigan 425 feet, and towards Portage Lake a distance of 148 feet from the shore-line. The rest of the distance to the smaller lake is unrevetted at present. It is more than likely that additional work will be required to make the present south revetment, and about 100 feet of the north revetment, secure, as the piles along the channel faces were not driven deep enough at first, so that eventually when the channel is dredged to its full depth there will be danger of undermining. In consequence of the large sand-spit in what is to be the channel, and on account of the piers not extending sufficiently far into Lake Michigan, the channel shoals gradually each year, necessitating some dredging every few years in order to assist local commerce and prevent what practically amounts to a closure of the entrance.

During the past year the following work has been done on the north revetment: Commencing at the outer end of the pile work the filling for 350 feet was overhauled and refilled with edgings and stone, and additional edgings were placed, wherever necessary, along the entire revetment. In all 177 cords of edgings and 75 cords of stone were required. This work was done by hire of labor and with purchased material.

Under date of March 24, 1885, a contract was entered into with Messrs. Truman & Cooper, of Manitowoc, Wis., to dredge a cut 50 feet wide and 12 feet deep, between Lake Michigan and Portage Lake, and also to dredge the site for inner extension of the south revetment. The work in the channel has been completed, requiring the removal of 9,622 cubic yards of material. The work on the site of south revetment is progressing favorably, and at the end of the fiscal year 10,120 cubic yards of material had been removed. The depth of this cut is 14 feet below water surface; the object being to place the bottom of the work at such a depth that it will not be undermined when the channel is dredged to the proposed depth of 18 feet.

As stated in previous reports, sound economy would indicate that appropriations for this work should be sufficiently large to complete it within the shortest time possible. As soon as the piers are carried out to the proposed depth in Lake Michigan and the channel dredged, the tendency to shoaling between the piers that now exists will disappear, and the dredging which now is needed yearly to keep a channel open for local commerce will not be required. I would respectfully recommend that $150,000 be appropriated for the fiscal year ending June 30, 1887, as that amount can be economically expended.

The work is in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, and the nearest light-house is the Manistee light.

Original estimated cost of work, 1879	$189,860 00
Whole amount appropriated from 1879 to 1885, inclusive	67,500 00
Whole amount expended	58,491 08

Money statement.

July 1, 1884, amount available		$5,583 19
Amount appropriated by act approved July 5, 1884		12,500 00
		18,083 19
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,296 98	
July 1, 1885, outstanding liabilities	1,777 29	
		9,074 27
July 1, 1885, amount available		9,008 92

Amount (estimated) required for completion of existing project	197,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	150,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened March 10, 1885, *by Capt. D. W. Lockwood, Corps of Engineers, for improving harbor of refuge at Portage Lake, Michigan.*

No.	Names and residences of bidders.	Dredging, per cubic yard, measured in scows.	Total.
		Cents.	
1	Green Bay Dredge and Pile Driver Company, Green Bay, Wis	17½	$5,775 00
2	Truman & Cooper, Manitowoc, Wis	12¾	*4,207 50
3	Christopher H. Starke, Milwaukee, Wis	14	4,620 00
4	Thomas M. Hubble, Saginaw, Mich	18	5,940 00
5	Dodge & Petrie, Little Falls, N. Y	12$\frac{9}{10}$	4,257 00
6	Carkin. Stickney & Cram, East Saginaw, Mich	18	5,940 00
7	Robert Finch, Grand Haven, Mich	15	4,950 00
8	Castle Sutherland, East Saginaw, Mich	18	5,940 00

* Award recommended.

Contract with Truman & Cooper, dated March 24, 1885, expiring August 31, 1885, for dredging.

K K 4.

IMPROVEMENT OF MANISTEE HARBOR, MICHIGAN.

The improvement at this harbor consists of a dredged channel connecting Lower Manistee River with Lake Michigan, the sides being protected by pile revetments and piles extending into the lake.

The width of the channel is about 170 feet at the entrance.

The north pier, with revetment, is 2,286 feet long, and extends into the lake beyond the shore-line about 760 feet.

The work is still effective throughout, although a portion of the superstructure is somewhat decayed.

The south pier, with revetment, is 1,472 feet long, and extends into the lake about 670 feet. The crib-work is in fair condition, and the revetment, although badly decayed in places in consequence of its backing of edgings, is still sand-tight and effective.

Depth of water.—Vessels are able to enter and leave drawing 12 feet, which is about the full capacity of the harbor at present.

During the past year the only work done has been in making repairs of damages caused by collisions. The Flint and Pere Marquette steamer No. 1 ran into the north revetment about abreast of the light-keeper's dwelling while bound out. On July 26, and before arrangements were completed for repairing the break, she repeated the operation. On October 25 the Goodrich steamer Depere, bound in, struck the bar, and somehow brought up across the end of the north pier, causing some damage.

The channel between Manistee Lake and Lake Michigan, is located between high sand-bluffs, and as the current is usually quite pronounced, large quantities of sand are annually carried out to be deposited in advance of the piers. In consequence there is a broad, flat bar at the entrance, over which, at low water in the lake, but 13 feet depth is found.

The present project provides for extending the piers to the 14-foot curve beyond the bar, and the amount of money required to do this is estimated at $102,700, exclusive of the appropriation of $10,000 in river and harbor act approved July 5, 1884. Of this amount I consider that $50,000 can be profitably expended during the fiscal year ending June 30, 1887, and I respectfully recommend that this amount be appropriated to be expended in pier extension.

Under date of October 21, 1884, a contract was entered into with Duncan Dewar, of Ludington, Mich., to place one crib, 50 feet long by 30 feet wide, on pile foundation in extension of south pier. This work has not been completed as yet, and the time for completing the contract has been extended to August 30, 1885.

As no appropriation has been made for the fiscal year ending June 30, 1886, it is deemed advisable to retain the balance of funds on hand. after paying for the crib now contracted for, to meet contingencies, such as dredging the channel in case it should become necessary and repairing damages caused by collisions.

This work is located in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, Michigan. A light is shown near the head of south pier.

Original estimated cost, 1866, amended 1875	$234,000 00
Whole amount appropriated, 1866 to 1885, inclusive	228,000 00
Whole amount expended	216,259 87

Money statement.

July 1, 1884, amount available	$2,668 30
Amount appropriated by act approved July 5, 1885	10,000 00
	12,668 30
July 1 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	928 17
July 1, 1885, amount available	11,740 13
Amount (estimated) required for completion of existing project	102,700 00
Amount that can be profitably expended in fiscal year ended June 30, 1887	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened September 29, 1884, *by Capt. D. W. Lockwood, Corps of Engineers, for improving harbor at Manistee, Mich.* (*one crib* 50 *by* 30 *by* 22 *feet on pile foundation*).

Material.	W. R. Laird, Manistee, Mich.	Duncan Dewar, Ludington, Mich.*	Carkin, Stickney & Cram, East Saginaw, Mich.
Piles, foundation, in place ... per linear foot	$1 38	$1 00	$2 00
Piles, sheet, in place ... do	86	50	45
Timber, oak, in place ... per M feet, B. M.	45 00	40 00	50 00
Timber, hemlock, in place ... do	23 00	24 00	29 00
Timber, pine, in place ... do	25 00	26 00	33 00
Plank, pine, in place ... do	25 00	26 00	26 00
Screw and washer bolts, in place ... per pound	06	08	08
Drift bolts and straps, in place ... do	04¼	03	05
Wrought spike, in place ... do	06	08	05
Stone, in place ... per cord	11 80	11 00	14 00
Cedar bark, in place ... do	7 00	4 00	10 00
Brush, in place ... do	7 00	4 00	10 00
Dredging ... per cubic yard	2 00	75	1 00
Total	6,711 91	6,064 48	7,930 58

*Award recommended.

Contract with Duncan Dewar, dated October 21, 1885, expiring June 30, 1885 (extended to August 30, 1885), for pier construction.

STATEMENT OF COMMERCIAL STATISTICS, MANISTEE HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	3,560
Revenue collected	$1,145 29

K K 5.

IMPROVEMENT OF LUDINGTON HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—The available depth for navigation was 14 feet.

The present improvement consists of a dredged channel about 200 feet wide connecting Pere Marquette Lake with Lake Michigan, its sides being protected by revetments and piers extending into Lake Michigan. The south pier with revetment is 1,679 feet long, its outer end being 1,029 feet beyond the shore-line. The north pier with revetment is 900 feet long, and in addition to this is a slab-dock 580 feet long in continuation eastward of the revetment, owned, occupied, and kept in repair by the Pere Marquette Lumber Company. The outer end of the pier is 650 feet beyond the shore-line.

The piers and revetments at the close of the fiscal year were in fair condition, requiring but nominal repairs.

This harbor is one of the Lake Michigan termini of the Flint and Pere Marquette Railway, and is specially important on that account. A daily line of steamers runs between this port and Milwaukee in connection with the railway, and in addition the Goodrich Company has boats also on this line. The railway steamers make regular trips during the winter when the weather will permit and in ordinary seasons interruptions from storms and ice are infrequent. Last winter, however, owing to extreme cold, the lake was filled with ice in large masses and delays were numerous and at times serious.

Owing to the fact that there is no harbor on this shore north of Grand Haven which will admit the larger class of vessels engaged in lake commerce and which has an entrance sufficiently wide to afford easy access in stormy weather, the question of establishing a harbor of refuge at some point near the line usually followed by large vessels engaged in the through trade has been under consideration for several years past. Under date of March 7, 1882, the late Maj. Franklin Harwood, Corps of Engineers, made a report on the subject recommending the construction of an exterior breakwater sufficiently extensive to afford the necessary shelter in heavy weather.

Under date of October 27, 1883, a report on the same subject was made by myself, and in the latter part of December, 1884, a Board of Engineers was convened by paragraph 1, Special Orders No. 181, "for the purpose of examining the harbor at Ludington, Mich., and reporting a plan with an estimate of cost for making a harbor of refuge at that place in accordance with the requirements of the river and harbor act of August 2, 1882."

The Board recommended that the present entrance to Pere Marquette Lake be widened to 400 feet by constructing a new south pier 400 feet south of the north pier, then to remove the present south pier and dredge the channel to a depth of 18 feet. The cost of the proposed change was estimated at $419,185.20.

In his letter of January 6, 1885, transmitting the report of the Board to the honorable Secretary of War, the Chief of Engineers, U. S. Army, stated that "the views and recommendations of the Board meet with my concurrence.

Under date of October 21, 1884, a contract was entered into with Mr. Chauncey E. Mitchell, of Ludington, Mich., to place a crib 50 feet long by 30 feet wide on pile foundation in extension of the south pier, but owing to the change of project, already given, the contract was modified so as to permit of sinking a crib 50 feet long and 24 feet wide in extension of the north pier.

The crib was sunk in the latter part of June, 1885, and part of the superstructure was put on. The original time for completing this work was June 30, 1885, but for various reasons the time of completion was extended by the Chief of Engineers, U. S. Army, to July 15, 1885.

As it is considered highly important that the work of widening the entrance to 400 feet should be pushed continuously to completion when once begun, I would respectfully recommend that $250,000 be appropriated for the fiscal year ending June 30, 1887, as this amount can be economically expended on the work.

This work is located in the Michigan collection district, Michigan. The nearest light-house is located at Sable. A light is shown near the end of south pier. The nearest port of entry is Grand Haven, Mich.

Original estimated cost of work 1866, amended 1879	$213,757 67
[illegible]	419,155 20
Whole amount appropriated from 1866 to 1885, inclusive	235,155 00
Whole amount expended	229,298 38

Money statement.

July 1, 1884, amount available		$1,582 25
Amount appropriated by act approved July 5, 1884		10,000 00
		11,582 25
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$951 20	
July 1, 1885, outstanding liabilities	3,754 43	
		4,705 63
July 1, 1885, amount available		6,876 62
Amount (estimated) required for completion of existing project		419,155 20
Amount that can be profitably be expended in fiscal year ending June 30, 1887		250,000 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals received and opened September 29, 1884, by Capt. D. W. Lockwood, Corps of Engineers, for improving harbor at Ludington, Mich. (one crib, 50 by 30 by 22 feet on pile foundation).

Materials.	W. H. Smith, Manistee, Mich.	Chauncey E. Mitchell, Ludington, Mich.*	Duncan Dewar, Ludington, Mich.	Clarkin, Mahoney & Oram, East Saginaw, Mich.
Piles, foundation, in place . . . per linear foot	[illegible]	[illegible]	[illegible]	[illegible]
Piles, sheet, in place . . . do	[illegible]	[illegible]	[illegible]	75
Timber, oak, in place . . . per M feet, B. M.	[illegible]	[illegible]	[illegible]	[illegible]
Timber, hemlock, in place . . . do	[illegible]	[illegible]	[illegible]	[illegible]
Timber, pine, in place . . . do	[illegible]	[illegible]	[illegible]	[illegible]
Plank, pine, in place . . . do	[illegible]	[illegible]	[illegible]	[illegible]
Screw and washer bolts, in place . . . per pound	[illegible]	[illegible]	[illegible]	[illegible]
Drift-bolts and straps, in place . . . do	[illegible]	[illegible]	[illegible]	[illegible]
Wrought spikes, in place . . . do	[illegible]	[illegible]	[illegible]	[illegible]
Stone, in place . . . per cord	[illegible]	[illegible]	11 00	15 00
Cedar work, in place . . . do	3 [illegible]	3 [illegible]	4 00	10 00
Brush, in place . . . do	5 [illegible]	3 [illegible]	4 00	10 00
Dredging . . . per cubic yard	[illegible]	—	[illegible]	1 00
Total	[illegible]	[illegible]	[illegible]	[illegible]

*Award recommended.

Contract with Chauncey E. Mitchell, dated October [illegible], 1884; modified April 17, 1885; expiring June 30, 1885 (extended to July [illegible], 1885), for pier construction.

Statement of commercial statistics, Ludington Harbor, Michigan, from July 1, 1884, to June 30, 1885.

Vessels entered and cleared	1,468
Revenue collected	$[illegible] 57

K K 6.

IMPROVEMENT OF PENTWATER HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—Between the piers, about 12 feet. The last survey showed no traces of a bar formation in advance of the piers, the depth generally increasing in about the same manner as along the shore on either side of the piers.

The improvement consists of a dredged channel 150 feet wide, connecting Pentwater Lake with Lake Michigan, and protected on both sides by piers and revetments. The south pier extends into Lake Michigan beyond the shore line 645 feet, and the north pier 700 feet.

During the past season the following work has been done:

To north pier.—The filling of a section 106 feet in length near the shore line was removed and replaced with brush fascines, loaded with stone. The backing of about 150 feet of the revetment was overhauled and brush fascines put in to stop leakage of sand through and under the filling of the revetment proper. The outer end of crib with modified superstructure was repaired as well as possible, by putting in a section of timbers bolted together, and fastening it to the uninjured timbers of the end wall but as the break made by the steam-barge Norman in the fall of 1883 extended down 9 feet below the water surface, the work could not be made very secure, and, although well backed with stone, was carried away during the winter.

In the fall of 1884 a crib that had been built at Muskegon, but which could not be placed in position for lack of funds, was towed to Pentwater to be sunk in extension of north pier. Owing to heavy weather, it was impossible to properly place the crib upon its arrival, and it was left between the piers, where it remained during the winter. This last spring it was sunk on a pile foundation in extension of the north pier, and to prevent its being damaged by vessels running into it a row of heavy piles was driven next to the end wall and secured to it by heavy binders and a wale piece.

In the south pier. The interval between the two outer cribs was filled with brush fascines loaded with stone. The filling in a section of the pile pier, 80 feet long, was taken out and replaced with brush fascines loaded with stone. During the year all the work was done by hired labor and purchased material.

In order to secure a proper depth of water at the entrance, it is considered necessary to extend the south pier 300 feet in all, and it is respectfully recommended that $40,000 be appropriated for this purpose for the fiscal year ending June 30, 1887.

This work is located in the Michigan collection district, Michigan. The nearest light-house is at Little Point Sable; a light is shown near head of south pier, and the nearest port of entry is Grand Haven, Mich.

Original estimated cost of work 1866, amended 1873	$192,020 00
Whole amount appropriated from 1866 to 1885, inclusive	207,820 00
Whole amount expended	203,474 32

Money statement.

July 1, 1884, amount available		$2,823 64
Amount appropriated by act approved July 5, 1884		15,000 00
		17,823 64
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$12,783 93	
July 1, 1885, outstanding liabilities	694 03	
		13,477 96
July 1, 1885, amount available		4,345 68

Amount (estimated) required for completion of existing project	$55,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	40,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

STATEMENT OF COMMERCIAL STATISTICS, PENTWATER HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	187
Revenue collected	$69 17

K K 7.

IMPROVEMENT OF WHITE RIVER HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—Between the piers, 11 feet, with no bar in advance of the entrance. The improvement consists of a dredged channel, varying in width from 190 to 200 feet, connecting White Lake with Lake Michigan, and protected by parallel piers. The south pier is 1,850 feet long, and extends into Lake Michigan 750 feet. The north pier is 1,500 feet long, and extends into Lake Michigan 476 feet.

With the exception of 356 feet of crib-work, the south pier is of pile construction, while the north pier, is entirely of pile-work. The piles are nearly all decayed more or less, especially at about the water-line, and in consequence, as the depth of water in advance of the entrance has been good for several years, it has been considered of more importance to secure the inner work, which, from its tumbled-down condition, readily permitted sand to pass through into the channel, than to extend the piers into Lake Michigan. Duringthe year just passed 752 feet of the pile revetment of south pier was rebuilt. The piles were cut down to the upper surface of the wale-streak and a timber superstructure was built up on them as a foundation, the cross-ties being placed 8 feet apart between centers. As it was evident from the shoal water along the channel-face of the work that the old filling was not sand-tight, it was entirely removed and replaced with edgings placed parallel to the axis of the pier. The old filling was found to consist of drift logs, short slabs, and in fact almost entirely of such refuse as can at any time be picked up on the lake beach; and as it was impossible to lay it regularly there was an almost constant leakage of sand through the revetment. In addition to the foregoing, the stone filling was removed for a distance of 215 feet at outer end of south pier, and aprons put down behind pile-work to prevent stone from working out, after which the stone was replaced. Four sand leaks were closed near the shore-line on same side. These leaks resulted from the fact that the old filling had never been put down to the bottom. This work was done by hire of labor and with purchased material.

The condition of the north pier is such that in order to save what is left of the old work above water it has become absolutely necessary to rebuild the superstructure of the pier-head, which is 40 feet wide by 45 feet long. The upper surface of the filling is 8 feet below the lake level at present.

For continuing pier extension of both piers and renewing entire old superstructure of pile-work above water-line, $50,000 can be expended to advantage during the fiscal year ending June 30, 1887, and it is respectfully recommended that this amount be appropriated.

The work is located in the Michigan collection district, Michigan, and is situated at the White River Light. The nearest port of entry is Grand Haven, Michigan.

Original estimated cost of work, 1866, amended 1873	$220,445 56
Whole amount appropriated from 1866 to 1885, inclusive	237,550 00
Whole amount expended	231,176 58

Money statement.

July 1, 1884, amount available		$2,763 44
Amount appropriated by act approved July 5, 1884		10,000 00
		12,763 44
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,865 09	
July 1, 1885, outstanding liabilities	524 93	
		6,390 02
July 1, 1885, amount available		6,373 42
Amount (estimated) required for completion of existing project		94,225 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

STATEMENT OF COMMERCIAL STATISTICS, WHITE RIVER HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	1,416
Revenue collected	$476 16

K K 8.

IMPROVEMENT OF MUSKEGON HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—Between the piers and across the bar beyond them an available depth of 15 feet existed.

The piers and revetments were in a serviceable condition.

During the past year the following work was done by hired labor and purchased material: The superstructure on the detached section of north pier was placed in position, filled with stone, and decked over. The section above referred to is 250.8 feet long and its construction was recommended by a Board of Engineers, convened by Special Order No. 92, series of 1880, headquarters Corps of Engineers, U. S. Army, Washington, D. C., with a view of increasing the width of the entrance from 185 to 300 feet. One effect of the construction of the detached section has been to cause an eddy just in advance of the old north pier, where a hole 35.5 feet deep has been excavated. The end of the old pier has been undermined, and in consequence of having been struck by a vessel going in, is badly wrecked. It is thought that when the new north pier has been carried further out the trouble that has been caused heretofore by the seas breaking about its outer end and meeting those coming in through the gap in-shore will to a certain extent cease.

Under date of October 21, 1884, a contract was entered into with Mr. Hiero B. Herr, of Chicago, Ill., to place two cribs, 50 feet long by 30 feet wide, on pile foundation, in extension of the detached north pier. The work was to have been completed by June 30, 1885; but under date of June 8 the time for completion was extended by the Chief of Engineers to August 31, 1885.

To complete the harbor in accordance with the present project it is estimated that $113,625 will be required, and I would respectfully recommend that $100,000 of this amount be appropriated for the fiscal year ending June 30, 1887.

This work is located in the Michigan collection district, Michigan, and is situated at the Muskegon Light. The nearest port of entry is Grand Haven, Mich.

Original estimated cost of work 1866, amended 1879	$168,901 75
Whole amount appropriated from 1866 to 1885, inclusive	221,500 00
Whole amount expended	203,940 86

Money statement.

July 1, 1884, amount available		$2,758 80
Received by sale of crib to Pentwater Harbor		2,068 63
Amount appropriated by act approved July 5, 1884		20,000 00
		24,827 43
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,760 89	
July 1, 1885, outstanding liabilities	507 40	
		7,268 29
July 1, 1885, amount available		17,559 14
Amount (estimated) required for completion of existing project		113,625 00
Amount that can be profitably expended in fiscal year ending June, 30, 1887		100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened September 29, 1884, by Capt. D. W. Lockwood Corps of Engineers, for improving harbor at Muskegon, Mich. (two cribs on pile foundation.)

Materials.	White & Finch, Grand Haven, Mich.	Knapp & Gillen, Racine, Wis.	George Talbot, Buffalo, N. Y.	Petrie Lumber Company, Muskegon, Mich.	Thomas W. Kirby, Grand Haven, Mich.	Hiero B. Herr, Chicago, Ill.*	Carkin, Stickney & Cram, East Saginaw, Mich.
Piles, foundation, in place, per linear foot	$1 00	$0 90	$1 10	$0 80	$0 95	$1 00	$1 25
Piles, sheet, in place, per linear foot	30	25	25	30	20	20	25
Timber, oak, in place, per M feet, B. M	40 00	40 00	40 00	35 00	40 00	30 00	45 00
Timber, hemlock, in place, per M feet, B. M	24 00	23 00	24 00	20 00	24 00	20 00	24 00
Timber, pine, in place, per M feet, B. M	27 00	28 00	30 00	24 00	29 00	23 00	28 00
Plank, pine, in place, per M feet, B. M	27 00	18 00	25 00	20 00	26 00	22 00	22 00
Screw and washer bolts, in place, per pound	05	06	05	08	06	05	08
Drift-bolts, in place, per pound	05	04½	04	04½	04½	04	05
Wrought spike, in place, per pound	05	05	04	04	05	05	05
Stone, in place, per cord	11 00	12 00	12 00	10 50	11 50	11 00	14 00
Cedar bark, in place, per cord	4 00	4 00	5 00	3 00	4 00	3 00	6 00
Brush, in place, per cord	4 00	4 00	5 00	3 00	4 00	3 00	6 00
Dredging, per cubic yard	60	40	1 00	50	75	35	1 00
Total, for one crib	6,033 00	5,988 43	6,845 26	5,420 63	6,069 04	5,358 39	6,908 48

*Award recommended.

Contract with Hiero B. Herr, dated October 21, 1884, expiring June 30, 1885 (extended to August 31, 1885), for pier construction.

STATEMENT OF COMMERCIAL STATISTICS, MUSKEGON HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	6,112
Revenue collected	$1,621.34

K K 9.

IMPROVEMENT OF GRAND HAVEN HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—There is an available depth on the bar of full 18 feet, while between the piers there is a channel of even greater depth up to the railway docks.

The piers and revetments are in a serviceable condition, although some repairs are needed on the north pier and the inner revetment on the south side, where the filling has settled so that its upper surface is generally below the water-level.

WORK DURING THE YEAR.

The two outer cribs of south pier were refilled with ballast and decked over, and the 710 feet of crib-work, beginning at the shore-line of same pier, which had been resuperstructured prior to July 1, 1884, were refilled with cedar bark and stone and decked over.

A section 140 feet long of inner revetment, south side, was completely overhauled, the filling removed to a depth of 6 feet below the water surface, and new filling and ballast put in.

On the north side a section of the revetment 802.5 feet long, extending from the old life-saving station outward, was completely rebuilt above the upper surface of the old wale streak of the channel row of piles. The old filling, which was of edgings placed crosswise of the revetment, was removed and new filling put in, the edgings being placed parallel to the axis of the work. The new superstructure is 5.3 feet high above low water. The work mentioned was all done by hire of labor and with purchased material.

Under date of October 21, 1884, a contract was entered into with Mr. Hiero B. Herr, of Chicago, Ill., to place four cribs 50 feet long by 30 feet wide on pile foundation, in extension of south pier. The time originally fixed for completion was June 30, 1885, but under date of June 5, 1885, this was changed by the Chief of Engineers, U. S. Army, to August 31, 1885.

The permanent completion of this harbor depends upon the extension of the present piers so as to secure sufficient depth of water at the entrance to permit vessels to enter in any weather; and I would respectfully recommend that $150,000 be appropriated for the fiscal year ending June 30, 1887, in order to carry out this plan at as early a date as possible.

This work is located in the Michigan collection district, Michigan, and is situated at the Grand Haven lights. Grand Haven is a port of entry.

Original estimated cost of work, 1866	$352,770 47
Whole amount appropriated from 1852 to 1885, inclusive	494,366 15
Whole amount expended	452,605 83

Money statement.

July 1, 1884, amount available		$1,328 43
Amount appropriated by act approved July 5, 1884		50,000 00
		51,328 43
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,448 11	
July 1, 1885, outstanding liabilities	120 00	
		9,568 11
July 1, 1885, amount available		41,760 32
Amount (estimated) required for completion of existing project		210,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		150,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened September 29, 1884, by Capt. D. W. Lockwood, Corps of Engineers, for improving harbor at Grand Haven, Mich. (four cribs on pile foundation.)

Materials.	Carkin, Stickney & Cram, East Saginaw, Mich.	White & Finch, Grand Haven, Mich.	Hiero B. Herr, Chicago, Ill.*	Knapp & Gillen, Racine, Wis.	George Talbot, Buffalo, N. Y.	Thomas W. Kirby, Grand Haven, Mich.
Piles, foundation, in place..per lin. foot..	$1 25	$1 00	$1 00	$0 90	$1 10	$0 90
Piles, sheet, in place............do....	25	30	20	25	25	20
Timber, oak, in place .per M feet, B. M..	45 00	40 00	30 00	30 00	40 00	30 00
Timber, hemlock, in place.........do....	26 00	24 00	20 00	22 00	24 00	22 00
Timber, pine, in place.............do....	30 00	26 00	23 00	28 00	30 00	27 00
Plank, pine, in place..............do ...	24 00	26 00	22 00	18 00	25 00	24 00
Screw and washer bolts, in place..per lb.	08	05	06	08	06	05
Drift-bolts, in place...............do....	05	05	04	04½	04	04
Wrought spikes, in place...........do....	05	05	05	05	04	05
Stone, in place..................per cord..	12 00	11 00	11 00	11 50	12 00	11 00
Cedar bark, in place...............do....	6 00	4 00	3 00	4 00	5 00	3 00
Brush, in place....................do....	6 00	4 00	3 00	4 00	5 00	3 00
Dredging..............per cubic yard..	60	60	35	40	60	15
Total for one crib..................	6,580 90	6,005 19	5,353 39	5,814 82	6,315 18	5,580 62

* Award recommended.

Contract with Hiero B. Herr, dated October 21, 1884, expiring June 30, 1885 (extended to August 31, 1885), for pier construction.

STATEMENT OF COMMERCIAL STATISTICS, GRAND HAVEN HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	1,634
Revenue collected	$1,985 43

K K 10.

IMPROVEMENT OF GRAND RIVER, BELOW GRAND RAPIDS, MICHIGAN.

The river and harbor act approved July 5, 1884, appropriated $25,000 for continuing the improvement of this river.

Before submitting a complete project for the expenditure of this amount, and in order to obtain more accurate information concerning the general character of the river-bed, I, under date of July 23, 1884, asked for authority to make "special surveys to cover the localities embracing the shoals."

This authority having been granted by the Chief of Engineers, U. S. Army, under date of July 31, 1884, the field work of the survey was commenced August 25, and closed October 11, 1884, the river having risen to such a height as to render further work impracticable. The survey covered 11¼ miles of the river, measured along its axis, and was in great detail so far as soundings were concerned. Gauges were set up at suitable points, connected by a continuous line of levels along the left bank, and read daily while depths were being determined. The soundings were taken as near low water as was possible; in fact, the greatest reduction that had to be applied at any time to reduce to this stage was six-tenths of a foot. The survey does not cover all the shoal places in the river, as several are known to exist further down-stream, but as it was desired to obtain only the most reliable data, it was closed as soon as the existing stage of water made large reductions necessary in reducing to low water.

As the plan of improvement had, under previous appropriations, been to relieve low-water navigation for light-draught boats, estimates were made for securing a channel 60 feet wide, with depths at low water of 4.5, 5.5, and 6.5 feet respectively.

To secure a depth of 4.5 feet with the above width, the length of cut within the limits of the survey (11¼ miles) was found to be 6.18 miles. For a depth of 5.5 feet the length of cut would have to be 9.54 miles, and for a depth of 6.5 feet the length would be 10.57 miles, or nearly continuous throughout the entire distance.

Under date of June 16, 1885, I forwarded a final project for continuing the improvement of the river, which was approved by the Chief of Engineers, U. S. Army, under date of January 23, 1885.

The project was "to dredge a cut 60 feet wide and 4.5 feet deep on the line indicated on tracing of map of survey." This line followed practically the line of deepest water. "The cut to commence at a point 1,800 feet below Godfrey's dock and extend to the foot of Howlett's Bar, opposite △ 14 of survey.

"The work to be done by contract after public advertisement in the usual manner."

After due advertisement proposals were opened March 10, 1885, and Robert Finch, being the lowest responsible bidder, was awarded the contract. Articles of agreement were entered into March 20, 1885. The cost of dredging per cubic yard of material measured on the lighters is as follows:

Sand, clay, and gravel, 25 cents; bowlders, 30 cents.

The contractor commenced work May 13, 1885, and by June 30 had removed from the cut material as follows:

Sand, clay, and gravel	cubic yards	13,243.75
Bowlders	do	869.05
Length of cut	feet	4,985
Width of cut was from	do	20 to 26

The material was dumped on the bank, or 157 feet from side of cut on slackwater side of river.

So far the amount of material removed, as measured in dump-cars, is about double what the estimate in place called for.

There are several ways in which this difference may be accounted for, and investigations are now in progress to determine definitely, or as definitely as may be, what the actual reason is.

As the permanency of the present cut is something that cannot be definitely determined at present, I do not consider that I can properly recommend the appropriation of more money until another season has passed. After another high water, and more especially after another ice-jam, should another occur like that of last winter, it will be possible to determine what actual improvement has been made to the navigation of the river. I must state that, in my opinion, based upon the results of the work of previous years, I do not consider the present improvement as permanent in its character.

Original estimated cost of dredging, 1881	$25,000 00
Whole amount appropriated from 1881 to 1885, inclusive	50,000 00
Whole amount expended	30,795 78

Money statement.

July 1, 1884, amount available		$386 04
Amount appropriated by act approved July 5, 1884		25,000 00
		25,386 04
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,718 97	
July 1, 1885, outstanding liabilities	2,462 85	
		6,181 82
July 1, 1885, amount available		19,204 22

Abstract of proposals received and opened March 10, 1885, by Capt. D. W. Lockwood, Corps of Engineers, for improving Grand River, Michigan.

No.	Names and residences of bidders.	Dredging, per cubic yard, measured on lighters.				Total.
		Sand.	Clay.	Gravel.	Bowlders.	
		Cents.	*Cents.*	*Cents.*	*Cents.*	
1	Kirby & Collister, Grand Haven, Mich	34	40	34	70	$14,772 04
2	Carkin Stickney & Cram, East Saginaw, Mich	28	60	28	75	12,649 48
3	Castle Sutherland, East Saginaw, Mich	35	35	35	60	14,901 20
4	Robert Finch, Grand Haven, Mich	25	25	25	80	*10,834 70
5	Green Bay Dredge and Pile Driver Company, Green Bay, Wis.	30	35	30	69	13,207 36

* Award recommended.

Contract with Robert Finch, dated March 20, 1885, expiring July 1, 1886, for dredging Grand River below Grand Rapids, Mich.

K K 11.

IMPROVEMEMENT OF BLACK LAKE HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water, 11 feet.

The piers beyond the shore-line were in a serviceable condition, having been thoroughly overhauled, with the exception of the two outer cribs of south pier, where from excessive settling the superstructure required renewal, the extreme outer end of the pier being between 6 and 7 feet below water surface. During the past winter an ice gorge formed across the channel, raising the water in Black Lake several feet above the water-level of Lake Michigan; when the gorge gave away the heavy current cut out the channel into the large lake, so as to give several feet increase of depth, which has continued to the present.

During the past year the following work has been done:

On the north pier general repairs commenced prior to July 1, 1884, were continued, the pier-head being filled with stone and decked over for a length of 73 feet. One hundred and fifty-three running feet of timber were placed in superstructure, and the sea-wall of the wide crib (36 feet) was rebuilt on the line of the regular pier, the offset, 8 feet wide, being decked over with 12-inch by 12-inch timber at the water surface.

The elevated walk on the south pier was taken down, and the old superstructure removed to the water-surface over a section of crib-work 442½ feet long, and then rebuilt, filled with stone, and decked over; 227 cords of stone were required in refilling the new superstructure.

From the end of this last work the same process was gone through with in rebuilding the superstructure over 148½ running feet of pile pier, except that brush was used in part for filling. All the work done was by hired labor and purchased material.

I would respectfully recommend that $20,000, the amount estimated for completion of this harbor, be appropriated for the fiscal year ending June 30, 1887.

This work is located in the Michigan collection district, Michigan, at the Holland light. The nearest port of entry is Grand Haven, Mich.

Original estimated cost of work, 1866	$106,238 04
Whole amount appropriated from 1852 to 1885, inclusive	254,615 31
Whole amount expended	250,614 24

Money statement.

July 1, 1884, amount available		$942 08
Amount appropriated by act approved July 5, 1884		15,000 00
		15,942 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$11,471 88	
July 1, 1885, outstanding liabilities	469 13	
		11,941 01
July 1, 1885, amount available		4,001 07

Amount (estimated) required for completion of existing project	20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATEMENT OF COMMERCIAL STATISTICS, BLACK LAKE HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	67
Revenue collected	$10 57

K K 12.

IMPROVEMENT OF SAUGATUCK HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—About all that can be depended upon is 8.5 to 9 feet, and to find this the channel must be well known.

The pier and revetments are in a dilapidated condition, but so far are serviceable inasmuch as they still retain their form and the material with which they are filled. Extensive breaks are liable to occur, however, at any time during the heavy weather which prevails on the lake during the fall and spring months.

All work that has been done at the harbor during the past year has been in accordance with the instructions contained in the letter of the Chief of Engineers, U. S. Army, to Major Heap, Corps of Engineers, under date of October 14, 1882, to wit:

> In carrying on operations at this harbor, you will be governed by the suggestion contained in the closing paragraph of the report (Report of Board of Engineers on Saugatuck Harbor, Michigan, dated Grand Rapids, Mich., June 28, 1882) whether the present depth is not sufficient for the present and prospective commerce, and whether the appropriation should not be applied merely to maintaining the existing condition of the improvement.

As the only work that could be done under the above instructions was that of "maintaining the existing condition of the improvements," the money that has been expended during the past year has been applied to overhauling and refilling the outer portion of the south pier, to secure the pier-head beacon, and stop leaks in the inner work where absolutely necessary. In all, 505 feet of the outer end of south pier was refilled with brush and stone, requiring 274 cords of the former and 114.5 cords of the latter. The work was done by hired labor and purchased material.

Experience has shown that to dredge a cut across the bar in advance of the entrance, in the prolongation of the channel, is useless, as the first heavy storms change the line of deepest water to the south, so that on entering or leaving vessels have to keep the two lights in line. I do not believe that much, if any, benefit would follow dredging on this last named line, as the depth that exists ordinarily is all that the discharge from the river can maintain.

To repair the revetments where necessary, refilling them with brush and stone, it is estimated that $8,000 will be required for the fiscal year ending June 30, 1887, and it is respectfully recommended that this amount be appropriated.

The work is located in the Michigan collection district, Michigan, and is situated at the Kalamazoo Light. The nearest port of entry is Grand Haven, Mich.

Original estimated cost of work 1866, modified 1869	$86,398 56
Whole amount appropriated from 1868 to 1885, inclusive	127,439 00
Whole amount expended	123,683 94

Money statement.

July 1, 1884, amount available	$1,729 59
Amount appropriated by act approved July 5, 1884	4,000 00
	5,729 59
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,974 53
July 1, 1885, amount available	3,755 06

Amount (estimated) required for completion of existing project	$8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	8,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATEMENT OF COMMERCIAL STATISTICS, SAUGATUCK HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	265
Revenue collected	$118 86

K K 13.

IMPROVEMENT OF SOUTH HAVEN HARBOR, MICHIGAN.

The condition of this harbor at the close of the fiscal year was as follows:

Depth of water.—On the bar outside the available depth was 14 feet, between the piers about 9 feet, and in the river to the railway dock 10.5 feet.

The improvement here consists of a dredged channel connecting South Black River with deep water in Lake Michigan, the channel being protected by parallel piers, about 180 feet apart, which extend into the lake beyond the shore-line, as follows: north pier, 797 feet; south pier, 560 feet. The entire length of the north pier is 1,590 feet, of which crib-work constitutes about 604 feet, the remainder being pile and plank-beam revetment.

The south pier is 1,500 feet long, 500 feet being crib-work, and the remaining 1,000 feet pile-pier and plank-beam revetment.

The end cribs of both piers have been injured by collisions and ice to such an extent as to require renewal of superstructure, and some additional ballast is required in other parts of the piers.

During the past year the filling of 447 feet of north pier was overhauled, and, where needed, additional bark was added. In the south pier, a section of 210 feet was treated in the same manner. This was done with a view to stopping the leakage of sand into the channel.

All work was done by hired labor and purchased material.

The old slab and pile pier on the north side of channel has not been taken out yet, as the Government dredge has been required elsewhere.

To complete this harbor the piers should be extended to deep water beyond the bar outside, and the piers and revetments now standing made sand-tight, and I would respectfully recommend that $40,000 for this purpose be appropriated for the fiscal year ending June 30, 1887.

The work is located in the Michigan collection district, Michigan, and is situated at the South Haven Light. The nearest port of entry is Grand Haven, Mich.

Original estimated cost of work 1866	$128,288 47
Whole amount appropiated from 1866, to 1885, inclusive	177,000 00
Whole amount expended	168,285 86

Money statement.

July 1, 1884, amount available		$2,841 61
Amount appropriated by act approved July 5, 1884		7,500 00
		10,341 61
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$1,513 51	
July 1, 1885, outstanding liabilities	113 96	
		1,627 47
July 1, 1885, amount available		8,714 14

Amount (estimated) required for completion of existing project........	$82,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	40,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATEMENT OF COMMERCIAL STATISTICS, SOUTH HAVEN HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	361
Revenue collected	$204 50

K K 14.

IMPROVEMENT OF SAINT JOSEPH HARBOR, MICHIGAN.

The available depth of water at this harbor is about the same as last year. There is a depth of 14 feet across the outer bar and inside to the dock below the railroad bridge. In Benton Harbor Canal there is about 11 feet.

There has been no material change in the condition of the piers during the past year, other than that due to a gradual decay of timber. The south pier will require a new superstructure in a few years, while a part of the north pier, inside of the shore-line, is in such condition that, were it not screened in a measure from the heavy seas, it would be torn out by the first storm.

No work has been done at this harbor during the past year.

During the coming fiscal year it is proposed to tear out a part of the old north pier, commencing at a point 400 feet east of the angles, and replace it with a pile revetment 14 feet wide. The new work will be on a line parallel to the present south pier.

No change has been made in the Chicago and West Michigan Railway Bridge during the past year.

The available width of the south draw (the only one used) has, if anything, been lessened by driving fender-piles at the abutments. The obstruction to navigation which this bridge constitutes has been so fully discussed in former reports that I do not deem it necessary to do more than to refer to it now.

So far the Cincinnati, Wabash and Michigan Railway Company has shown no disposition to carry out fully its agreement with regard to revetting the north bank of the Benton Harbor Canal.

To carry out the present plan of improvement for the harbor proper of Saint Joseph below the railway bridge, it is estimated that $51,015 will be required, and I would respectfully recommend that this amount be appropriated for the fiscal year ending June 30, 1887.

This work is located in the Michigan collection district, Michigan, and is situated at the Saint Joseph light. The nearest port of entry is Grand Haven Mich.

Original estimated cost of work as now being carried on	$128,288 47
Whole amount appropriated since adoption of present project, from 1836 to 1885, inclusive	332,613 00
Transferred to Grand Haven (Report 1870, page 44)	500 00
Whole amount expended	311,745 80

Money statement.

July 1, 1884, amount available	$6,235 31
Amount appropriated by act approved July 5, 1884	15,000 00
	21,235 31
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	868 11
July 1, 1885, amount available	20,367 20
Amount (estimated) required for completion of existing project	51,015 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	51,015 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATEMENT OF COMMERCIAL STATISTICS, SAINT JOSEPH HARBOR, MICHIGAN, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	467
Revenue collected	$361 57

K K 15.

IMPROVEMENT OF NEW BUFFALO HARBOR, MICHIGAN.

The only work done at this harbor during the past fiscal year was the completion of the extension to the pier east of the entrance, which was commenced about May 10, 1884, and the work was closed July 12, 1884, when the appropriation of May 2,1882, was exhausted.

There is less than 3 feet of water at the entrance, which enables only light-draught fishing boats to enter. So far as the commercial importance of the harbor is concerned, at present, it may safely be stated as insignificant.

Under date of February 28, 1882, Maj. J. A. Smith, Corps of Engineers, submitted a special report on this harbor, in which he gave plans and estimates for constructing a harbor at a cost of $150,500, and in his annual report for the fiscal year ending June 30, 1882, he stated:

> There is at present no definite project for the construction of a harbor at New Buffalo.

As I can find no record of any project having been approved since that date, I am inclined to believe that there exists none at this date.

Appropriations for this improvement, to be of any value, should be large enough to make some definite progress towards opening a channel and securing an entrance. Small appropriations will only be of temporary relief, and contribute but little, if any, towards lasting improvement.

The work is located in the Chicago collection district, and the nearest light-house is at Michigan City, Ind. The nearest port of entry is Chicago, Ill.

Original estimated cost of work 1866, modified 1868	$500,000
Whole amount appropriated from 1852 to 1885, inclusive	83,000
Whole amount expended	83,000

Money statement.

July 1, 1884, amount available	$729 89
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	729 89

K K 16.

IMPROVEMENT OF MICHIGAN CITY HARBOR, INDIANA.

The improvements at this place have been continued under the able supervision of Capt. J. A. Manning.

OUTER HARBOR.

The condition of this work at the close of the fiscal year was as follows:

Depth of water.—At the entrance between the piers there is a good channel, not less than 19 feet deep, and this at the shore-line holds good for 18 feet, so that the largest class of vessels, barges, and steamers have no difficulty in entering the harbor. The depths in the exterior harbor, now entirely inclosed excepting the entrance from the west, remain about the same as in former years.

CONDITION OF PIERS, BREAKWATER, &C.

The old west pier is in bad shape, and naturally continues to grow worse each year. Under the present plan for future improvement of the harbor it is contemplated to remove a portion of the north end of this pier, and consequently no extensive repairs to it have been made in late years, and all that will be done in future will be with the object of maintaining the existing state of affairs until such time as the completion of the advanced breakwater will permit of the removal of this part of the old harbor work. About 200 feet of this pier, however, near the shore-line, which is in an advanced stage of decay, and which is to be retained under the present plan, will be thoroughly overhauled and repaired, as in its present condition it readily permits the passage of sand through it to the detriment of the channel.

The exterior breakwater is in good condition and continues to the pile pier which forms the eastern line of protection to the outer harbor. The pile pier is in effective condition, only requiring additional ballast.

Since the repairs were made to the end of pier at west end of breakwater, little or no change has been noticeable there.

WORK DURING THE YEAR.

The end wall of the west harbor pier, having been seriously injured by vessels striking it, was removed and a new bulkhead put in its place. The decking of the breakwater was repaired from time to time, as during heavy gales planks are frequently torn out or broken by snags and logs thrown up by the heavy seas.

CRIB-BUILDING.

Three cribs, 50 feet long by 30 feet wide, were sunk on pile foundations during the summer and fall of 1884, to close the gap in the breakwater at its eastern extremity. These cribs were superstructured, filled with stone and decked over, the work being completed December 14, 1884. With the closure of this gap in the breakwater, the shoaling in the outer harbor will undoubtedly cease, as there is now no current sweeping through it to cause a movement of sand.

During 1885, so far one crib, 50 feet long by 30 feet wide, has been sunk on pile foundations in extension of the new breakwater pier. The crib was 26½ feet high. A second crib has been completed to the nineteenth course, and the foundation for it prepared.

The dredge excavated 18,370 cubic yards of material from the channel near the shore-line, in removing a shoal that had been caused by sand breaking through the old west pier.

During the winter the pile-driver, dredge, and scows were overhauled and put in effective shape.

All work at this harbor during the year has been done by hired labor and purchased material. The efficient condition and completeness of the plant owned by the Government here rendered this method more economical than that by contract.

ESTIMATES.

To complete the new east breakwater pier and construct the west exterior breakwater, in accordance with the report of the Board of Engineers, constituted by Special Orders No. 19, headquarters Corps of Engineers, United States Army, dated Washington, D. C., March 2, 1882, to consider and report upon the improvement of the harbor at Michigan City, Ind., it was estimated by Major Smith that it would require $450,000 (page 1968, Report of Chief Engineers for 1884), and as the construction of the breakwater when once commenced should be pushed to completion as rapidly as possible, I would respectfully recommend that $250,000 of the above amount be appropriated for the fiscal year ending June 30, 1887. The views and recommendations of the Board of Engineers, mentioned above, were concurred in by the Chief of Engineers under date of July 6, 1882.

Original estimated cost of work 1857, amended 1870 and 1882	$587,000 00
Whole amount appropriated from 1836 to 1885, inclusive	814,418 59
Whole amount expended	800,699 84

Money statement.

July 1, 1884, amount available		$4,628 47
Received by sale of stone to New Buffalo		308 00
Amount appropriated by act approved July 5, 1884		40,000 00
		44,936 47
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$24,009 34	
July 1, 1885, outstanding liabilities	7,208 38	
		31,217 72
July 1, 1885, amount available		13,718 75

Amount (estimated) required for completion of existing project	450,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	250,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

INNER HARBOR.

Owing to the favorable condition of the inner harbor, the dredge was not put to work until October 9, 1884, when she commenced excavating between the Packing House and the Michigan Central Railroad Bridge; two cuts were made on the north side of this section, with the result of obtaining 17 feet of water and the removal of 21,890 cubic yards of material.

To complete the dredging in the inner harbor it is estimated that $5,000 will be required, and it is respectfully recommended that this amount be appropriated for the fiscal year ending June 30, 1887. It is more than likely that even after the inner harbor is cleaned out, as contemplated by the present project, an occasional small appropriation will be required to maintain the necessary depth.

Original estimated cost of work 1870, amended 1878	$100,000 00
Whole amount appropriated from 1878 to 1885, inclusive	95,000 00
Whole amount expended	88,965 31

Money statement.

July 1, 1884, amount available		$517 85
Amount appropriated by act approved July 5, 1884		10,000 00
		10,517 85
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,779 07	
July 1, 1885, outstanding liabilities	704 09	
		4,483 16
July 1, 1885, amount available		6,034 69
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		5,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

These works are located in the Chicago collection district, and are situated at the Michigan City, Ind., light. The nearest port of entry is Chicago, Ill.

STATEMENT OF COMMERCIAL STATISTICS, MICHIGAN CITY, INDIANA, FROM JULY 1, 1884, TO JUNE 30, 1885.

Vessels entered and cleared	1,334
Revenue collected	$116 35

K K 17.

EXAMINATION OF LUDINGTON HARBOR, MICHIGAN, WITH A VIEW TO MAKING A HARBOR OF REFUGE AT THAT PLACE.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 6, 1885.

SIR: I have the honor to submit herewith a copy of a report, with accompanying papers, from a Board of Engineer officers constituted to comply with the requirements of the river and harbor act of August 2, 1882, with the view of reporting a plan with an estimate of cost for making a harbor of refuge at Ludington, Mich.

The views and recommendations of the Board meet with my concurrence.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF CAPTAIN D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Grand Rapids, Mich., November 29, 1884.

GENERAL: I have the honor to acknowledge the receipt of letter of the Hon. B. M. Cutcheon, M. C., to the Engineer Department, relative to a harbor of refuge at Ludington, Mich., referred to me for report, by indorsement dated "Office Chief of Engineers, U. S. Army, November 17, 1884."

In my report on this subject, dated October 27, 1883, I had the honor of submitting two plans for establishing a harbor of refuge at that place:

The first being to construct an exterior breakwater, parallel to the shore, north of the north pier, and this, in connection with an arm at its northern extremity running in towards the shore, and the extension of the south pier, would inclose a sheltered area for refuge in stormy weather.

The second plan was to widen the entrance to Pere Marquette Lake to 400 feet by constructing a pier at that distance south of the present north pier, and then to remove the present south pier, and dredge out the widened channel to a depth of 18 feet.

The estimated cost of the two plans was as follows:

First plan, exterior breakwater, &c	$861,260 00
Second plan, widening entrance	419,185 20

I would respectfully recommend the adoption of the second plan, for the following reasons:

1. Because it will cost less than one-half of what would be required for the first method.

2. Pere Marquette Lake affords a large sheltered area for anchorage and wharf facilities, and, once inside, a vessel would be perfectly safe in any weather. The width of entrance, 400 feet, is considered ample to insure a safe entrance.

3. Ludington, being one of the Lake Michigan termini of the Flint and Pere Marquette Railway, is a winter harbor, the railway steamers running all winter. At present, except in exceptionally severe weather, these steamers manage to make trips more or less regularly through the winter.

Should the exterior breakwater be put in, the sheltered area would freeze up early in the season, and the tendency would be towards closing the entrance to Pere Marquette Lake by drift ice accumulating against the solid ice behind and about the breakwater.

In order that an exterior breakwater at this point should answer all the requirements of affording shelter under any and all circumstances of wind and weather, it should be of such a character, so far as location and direction are concerned, that vessels can take refuge behind it in storms blowing along or on shore, and find comparatively quiet water and good holding ground.

The area to be inclosed, from economical reasons, should be as small as possible, regard being paid to the strict requirements of commerce. This would necessarily permit of but a single entrance, as otherwise there would be but a small area of quiet water at most times. In the present case the entrance near the piers would be protected from drift from the south by the prolongation of the south pier, but should another entrance be left at the northern end, drift from that direction would accumulate behind the breakwater, necessitating frequent dredging.

With the entrance as located on the plan furnished with my former report on the subject, vessels would have little or no trouble getting inside with the wind from the south or west, but with the wind from the northwest there would always be a heavy sea along and against the channel side of the south pier, and consequently the danger of striking would be great.

In short, to secure a proper refuge in all weather, it seems to me that the breakwater should be extended to the south, and the same arrangements made on that side of the piers as has been proposed for the north side. This has been found to be necessary at Chicago and Oswego, and at Michigan City. Major Smith, while in charge of that work, proposed a like plan.

The act of Congress of August 2, 1882, required an examination or survey, or both, to be made of "harbor at Ludington, Michigan, with a view to examination by a Board of Engineers, and report of a plan, and expense of same, for making a harbor of refuge." In view of the language of the act, I prepared the two plans, although I was in favor of the second one only.

In conclusion, I would say that it is of great importance that this question should be settled at an early date, as a contract has been made with Mr. Chauncey E. Mitchell to place one crib on pile foundation during the coming season, and it will depend upon the definite adoption of some plan for future improvement which pier is to be extended.

If the plan of an exterior breakwater is adopted, then the crib should be placed in extension of the south pier, while, if the second plan, widening the entrance to Pere Marquette Lake, is adopted, then the crib should be sunk in prolongation of the north pier; and finally, if a breakwater is to be built to the south as well as to the north of the piers, no further extension of the present piers is required. The great expense that would necessarily attend this latter plan, is, in my opinion, sufficient to bar its consideration.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER TRANSMITTING REPORT OF BOARD OF ENGINEERS.

LUDINGTON, MICH., *December* 29, 1884.

GENERAL: I have the honor to transmit herewith the report of the Board of Officers of the Corps of Engineers which assembled at Ludington, Mich., on Saturday, December 27, 1884, in pursuance of paragraph 1, Special Orders No. 181, headquarters Corps of Engineers, U. S. Army, Washington, D. C., December 16, 1884, "for the purpose of examining the harbor of Ludington, Mich., and reporting a plan with estimate of cost for making a harbor of refuge at that place, in accordance with the requirements of the river and harbor act of August 2, 1882."

The papers referred to the Board by letter from the office of the Chief of Engineers, dated December 17, 1884, are herewith returned, the map being in a separate package.

Very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS,
Ludington, Mich., December 29, 1884.

SIR: The Board of Engineer Officers constituted by paragraph 1, Special Orders No. 181, current series, from headquarters Corps of Engineers, "for the purpose of examining the harbor of Ludington, Mich., and reporting a plan with an estimate of cost for making a harbor of refuge at that place in accordance with the requirements of the river and harbor act of August 2, 1882," met at Ludington, December 27, with all the members present, and have the honor to submit the following:

The president of the Board submitted the copy of instructions from the Chief of Engineers, United States Army, with the following reports on the subject, to wit:

1st. Report of Maj. F. Harwood, Corps of Engineers, relative to the necessity for a harbor of refuge at Ludington, Mich., with plans and estimates therefor, and map accompanying same.

2d. Report of Capt. D. W. Lockwood, Corps of Engineers, on survey of "harbor of Ludington, Mich., with view to an examination by a Board of Engineers and report of a plan and expenses of same for making a harbor of refuge," as provided for in river and harbor act of August 2, 1882, with tracing accompanying the same.*

3d. Report of Capt. D. W. Lockwood, dated November 29, 1884, recommending a plan for proposed harbor of refuge.

After an examination of the harbor and site of the proposed work the Board met several lake captains and obtained their views with regard to the general subject of what would constitute a proper harbor of refuge at this point.

After discussion, the Board agreed upon the following conclusions:

1st. That Pere Marquette Lake affords a much greater area for anchorage than it is practicable to obtain in an outer harbor, and is ample to accommodate all the vessels that would be likely to seek shelter in it from stormy weather in Lake Michigan; that it is completely protected from the heavy seas and gales that may prevail on the larger lake by the sand-spit which separates the two, and which is a natural breakwater.

2d. The smaller lake being a natural harbor basin, when connected with the larger lake by a passage affording sufficient depth of water, and having an entrance in Lake Michigan easy of access in all weather, becomes a harbor of refuge of such a character as to meet the requirements of commerce.

3d. The present entrance to Pere Marquette Lake is 200 feet wide; this is not considered enough, and an increase of width to 400 feet is therefore recommended. In consequence of the location of the piers as they now are, this widening can only be effected by changing the south pier, and this can be done by constructing a new south pier parallel to and 400 feet from the present north pier, and then removing the present south pier and dredging the passage so as to obtain a depth of 18 feet of water. The Board further recommends that the north pier be extended to the 15-foot curve, and the new south pier be built out to the 22-foot curve. These piers can be subsequently further extended should it be found necessary to do so.

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* Printed as Senate Ex. Doc. 81, Forty-eighth Congress, first session.

An exterior breakwater, in order to afford a sufficient area behind it to enable vessels in storms to anchor with safety under its protection, would have to be located in deep water, and its cost of construction would therefore be great. The lake bottom in this locality is composed of sand, constituting bad holding ground, so that unless the structure was built well up above the water and practically inclosed the anchorage, there would probably still be trouble in vessels holding their own, even when anchored behind the breakwater.

The entrances would have to be limited in extent, otherwise the water inside would be much disturbed; in fact, while it would be possible to locate the work so that an entrance during storms from a certain direction would be comparatively easy and the protection sufficient, it might be found a serious matter to fulfill these requirements through a range in the direction of the wind of nearly 180°, with a breakwater limited in extent, and under the varying conditions of shore currents and consequent drift that exists here.

The cost of the plan recommended will probably be less than one-half that of an outer harbor, a fact which has been given due weight by the Board, as well as the additional fact that in the ordinary course of appropriations a much shorter time would be required to obtain the same extent of protection to shipping.

The detailed estimate of cost of widening the present entrance to Pere Marquette Lake, as recommended by the Board, is as follows:

800 feet pile revetment, with sheet piling, at $27.54	$22,032 00
South pier, 1,050 feet piering, 18 feet water, 6 feet superstructure, at $110.	115,500 00
650 feet piering, 20 feet water, 6 feet superstructure, at $150	97,500 00
North pier, 550 feet piering, 18 feet water, 6 feet superstructure, at $110.	60,500 00
Removing old pier	25,000 00
	320,85 500
10 per cent. contingencies	32,053 20
	352,585 20
Dredging 222,000 cubic yards, at 30 cents	66,600 00
Total	419,185 20

The cost of removing the old pier cannot be estimated with any great degree of accuracy; still the figures given above ($25,000) are deemed large enough to cover any contingencies.

There are, it is estimated, about 3,500 cords of stone in the old pier, most of which can be dredged up and saved.

All of which is respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers.
J. W. BARLOW,
Lieut. Col. of Engineers.
THOS. H. HANDBURY,
Major of Engineers.
D. W. LOCKWOOD,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

K K 18.

PRELIMINARY EXAMINATION OF LITTLE TRAVERSE BAY, NEAR THE VILLAGE OF PETOSKEY, WITH A VIEW TO CONSTRUCTING A HARBOR OF REFUGE.

UNITED STATES ENGINEER OFFICE,
Grand Rapids, Mich., October 25, 1884.

GENERAL: I have the honor to state that in obedience to your printed letter of September 4, 1884, I made a personal examination of Little Traverse Bay, near the village of Petoskey, September 27–29, and now respectfully submit the following report:

The clause in the river and harbor act approved July 5, 1884, calling for an examination or survey of this locality, states the object of such examination or survey to be "with a view to constructing a harbor of refuge."

Little Traverse Bay, is between 20 and 25 miles south of Waugoshance light, which marks the western entrance to the Straits of Mackinac. Its general direction is east and west, and it is exposed directly to winds from the northwest around to southwest. Its shores are bold, and in most places rocky.

I do not consider the locality worthy of improvement, for the following reasons:

1. There already exists on the north shore of the bay, and about 5 miles from Petoskey, a natural harbor of refuge, which is sheltered from winds from the north around to southwest.

During the past summer a light-house was built to mark the entrance, which is an easy one, with a sufficient depth of water to admit the largest vessels on the lake.

2. Little Traverse Bay is so far to the east of the course taken by vessels bound from the Straits of Mackinac to the different ports of Lake Michigan, or *vice versa*, that in nearly if not all cases such vessels would find it more to their advantage to seek shelter under the lee of the islands or in Grand Traverse Bay than in Little Traverse Bay, even if an additional place of refuge existed at its head.

The harbor at Harbor Springs is sufficient for the present needs of commerce, and as its use is and will continue to be confined to vessels engaged in the coasting trade only, there is little fear but that it will answer for years to come all the demands that may be made upon its capacity.

To establish a harbor of refuge on the south shore of the bay, near Petoskey, would require the construction of an extensive breakwater, which would have to be built in deep water in order to secure the requisite area for shelter. If located at Petoskey it would serve to protect the piers used by steamboats during the summer, but except in special cases would offer no advantages over Harbor Springs Harbor as a refuge in bad weather.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

APPENDIX L L.

IMPROVEMENT OF SAINT MARY'S RIVER—ENLARGEMENT OF, AND OPERATING, SAINT MARY'S FALLS CANAL—IMPROVEMENT OF CERTAIN HARBORS ON LAKE HURON, AND OF SAGINAW RIVER—CONSTRUCTION OF HARBOR OF REFUGE ON LAKE HURON, AND OF ICE-HARBOR AT BELLE RIVER—REPAIR AND PRESERVATION OF SAINT CLAIR FLATS CANAL—IMPROVEMENT OF DETROIT RIVER.

REPORT OF LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Hay Lake Channel, Saint Mary's River, Michigan.
2. Saint Mary's Falls Canal and River, Michigan.
3. Operating and care of Saint Mary's Falls Canal, Michigan.
4. Dry dock at Saint Mary's Falls Canal, Michigan.
5. Harbor at Cheboygan, Michigan.
6. Harbor at Thunder Bay, Mich.
7. Harbor at Au Sable, Mich.
8. Saginaw River, Michigan.
9. Harbor of refuge, Sand Beach, Lake Huron, Michigan.
10. Ice-harbor of refuge, Belle River, Michigan.
11. Repairs of Saint Clair Flats Canal, Michigan.
12. Operating and care of Saint Clair Flats Ship-Canal, Michigan.
13. Clinton River, Michigan.
14. Detroit River, Michigan.
15. Information concerning Portage Lake and Lake Superior Ship-Canal, &c.

EXAMINATIONS AND SURVEYS.

16. Mackinac Harbor, Michigan.
17. Pine River, Saint Clair County, Michigan.
18. For harbor of refuge at or near Cross Village, Mich.
19. Old locks at the Saint Mary's Falls Canal for use as a dry-dock.
20. Clinton River, Michigan.
21. Saint Clair River, Michigan, to ascertain whether the erosion of the right bank is injuring the navigation of the river and Saint Clair Flats Canal.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 21, 1885.

SIR: I have the honor to transmit herewith the annual reports relating to the works of river and harbor improvements under my charge for the fiscal year ending June 30, 1885.

I am, general, very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

L L 1.

IMPROVEMENT OF HAY LAKE CHANNEL, SAINT MARY'S RIVER, MICHIGAN.

The original estimates for this improvement were based upon a project for a channel 300 feet wide and 17 feet deep, leaving the present navigable channel of Saint Marys River at Sugar Island Rapids (about 2¼ miles below the canal), through these into Hay Lake, and then, by way of the Middle Neebish, rejoining the present navigable channel at the foot of Sugar Island, thus saving a distance of 11 miles, and obtaining a route which it is practicable to mark with lights so as to be navigable at night, a condition impracticable with the present channel.

The estimated cost of this improvement was $2,127,292.

This project was subsequently modified to increase the depth of the channel to 19 feet, and it is now proposed to further modify it to 20 feet.

These modifications will necessarily increase the cost, but not to so great an extent as would at first be supposed, because the prices at which the most difficult part of the work can be done are lower than those of the original estimate.

The data for making a close estimate of the ultimate cost of the 20-foot channel are as yet undetermined, but it is hoped that before the time comes for another annual report, these will have been obtained.

For the present purpose of an approximate estimate it is deemed safe to say, however, that the increased cost will not exceed 25 per cent. of the original estimate, thus making the amount $2,659.115.

Two appropriations have been made for the work, as follows, viz:

By act of Congress approved August 2, 1882	$200,000
By act of Congress approved July 5, 1884	125,000
Total	325,000

Except a few test pits at Sugar Island Rapids, the work of excavation has thus far been carried on at Middle Neebish only. This has been done under three contracts and by a hired dredge, viz:

(1) With John Hickler contract dated February 28, 1883, in the upper section, for a width of 100 feet and depth of 19 feet, at 72 cents per cubic yard, bank measurement.

Total amount excavated ... cubic yards	201,079
Of which the quantity removed from outside the specified prism, and therefore not paid for, was ... cubic yards	39,377.9
Paid for, at 72 cents per cubic yard	161,701.1
Amounting to	$116,424 79

Contract completed.

(2) With John Hickler, contract dated September 5, 1884, in the lower section, for a width of 100 feet and depth of 19 feet, at 58 cents per cubic yard, bank measurement.

Total amount excavated (of which 3,000 cubic yards are estimated and subject to change upon final examination) ... cubic yards	42,915
Which at 58 cents per cubic yard would amount to	$24,890 70

But this is subject to change upon final estimate.

Contract completed June 30, but final estimate not yet made.

(3) With Hickler & Green, contract dated May 18, 1885, in the middle section, for a width of at least 100 feet and depth of at least 14 feet, at 89 cents per cubic yard, bank measurement.

Total amount (estimated) excavated to July 1, 1885 ... cubic yards	3,000

(4) Experimental dredging with dredge and outfit under contract with Williams & Upham, dated August 13, 1884, at $8 per hour for the time actually working.

Total amount excavated to July 1, 1885, bank measurement.......cu. yds..	6,850
At a cost for dredge and outfit of	$5,669 07
And for drilling and blasting of..	3,249 58
	8,918 65

Or $1.34½ per cubic yard.

An additional quantity of material of unknown amount was removed whilst digging test pits in October, 1882, and May, 1883.

And certain shoals at Sailor's Encampment were removed in 1882 and 1883, by hired dredge, after drilling and blasting.

The total cost of this work was $15,225.79, of which the sum of $7,069.14 was charged to the appropriation for improving Hay Lake Channel, and the remainder, $8,156.65, to the appropriation for improving Saint Mary's River and Saint Mary's Falls Canal.

The details of the work performed during the fiscal year ending June 30, 1885, are given in the appended report of E. S. Wheeler, assistant engineer in local charge.

The advantages of this improvement are fully set forth in the report of the late Lieut. Col. G. Weitzel, dated January 14, 1882, printed as House Ex. Doc. No. 54, Forty-seventh Congress, first session, and at pages 2362 *et seq.* of the Annual Report of the Chief of Engineers for 1882.

Lieutenant-Colonel Weitzel's project contemplated a depth of 17 feet, and his estimates were based upon that depth.

It is now manifest that the commerce of the lakes will not be satisfied with anything less than the greatest depth practicable.

This is fixed by the practicable depth in Lake Saint Clair, which may be assumed at 20 feet, and all projects for general navigation should be modified to conform to that depth.

So far as the improvement of the water communication between Lake Superior and the Lower Lakes is concerned, it can now be done to better advantage, and at less cost than at any future time.

The additional cost which will be incurred by making the increased depth in the Hay Lake Channel is stated above, and the work should be prosecuted with all possible vigor.

Thus far the appropriations have not been sufficient to warrant undertaking operations at more than one locality. The extent of the line is so great, however (nearly 15 miles), that, with sufficient funds, a large plant could be simultaneously employed. With that object in view I respectfully recommend an appropriation of not less than $500,000, for the fiscal year 1886-'87. Even with such appropriations fully seven years would be occupied in accomplishing the result, and it will be well to remember that the improvement will not become available until the whole is completed.

It seems to me to be erroneous to consider this a work in which the State of Michigan alone is interested. In fact Michigan's interest is insignificant in comparison with that of New York, Pennsylvania, Ohio, Wisconsin, Minnesota, and the Territories of Dakota and Montana.

It is an important part of the system for the amelioration of the general navigation of the great Lakes, and if now available would be used by vessels carrying no less than 3,000,000 tons.

Contract in progress.

Estimated cost of the original project	$2,127,292
Appropriated to date	325,000
Estimated cost of the project now proposed—20-foot channel	2,659,115
Amount required to complete the work as proposed	2,334,115

The work is located in the collection district of Superior, Michigan. Marquette is the nearest port of entry, but Sault Sainte Marie is a subport.

The nearest light-house is the beacon at the west end of Saint Mary's Falls Canal.

Money statement.

July 1, 1884, amount available		$77,220 68
Received from sale of fuel		35 26
Amount appropriated by act approved July 5, 1884		125,000 00
		202,255 94
July 5, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$74,006 12	
July 1, 1885, outstanding liabilities	4,042 25	
		78,048 37
July 1, 1885, amount available		124,207 57
Amount (estimated) required for completion of existing project modified as proposed		2,334,115 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		500,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for furnishing one dredge, one tug, and two dump-scows for dredging in Hay Lake Channel and its dependencies, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 6, 1884, *in accordance with advertisement dated July* 23, 1884.

No.	Names and residences of bidders.	Price per hour.	Remarks.
1	Williams & Upham, L'Anse, Mich	$8 00	Recommended for acceptance.
2	John Hickler, Buffalo, N. Y	8 50 10 50	Dredge No. 4. Dredge No. 5.
3	Carkin, Stickney & Cram, East Saginaw, Mich	10 85	
4	George Talbot, Buffalo, N. Y	12 00	

Abstract of bids for furnishing groceries for subsistence of party employed in connection with the work for improving Hay Lake Channel, Saint Mary's River, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 23, 1884, *in accordance with paragraph* 1488, *United States Army Regulations*, 1881.

No.	Names and residences of bidders.	Total.
1*	G. & R. McMillan, Detroit, Mich	$156 65
2	Hull Brothers, Detroit, Mich	170 94
3†	Not signed, Detroit, Mich	166 72

* Accepted. † Informal.

Abstract of bids for improving Hay Lake Channel, Saint Mary's River, Michigan, dredging at Middle Neebish, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on September 1, 1884, *in accordance with advertisement dated August* 13, 1884.

No.	Names and residences of bidders.	Price per cubic yard in bank.
		Cents.
1*	John Hickler, Buffalo, N. Y	58
2	Carkin, Stickney & Cram, East Saginaw, Mich	61
3	Williams & Upham, L'Anse, Mich	63
4	Green Bay Dredge and Pile Driver Company, Green Bay, Wis	69
5	Dodge & Petrie, Little Falls, N. Y	70
6	Chicago Dredging and Dock Company, Chicago, Ill	70
7	Fitzsimons & Connell, Chicago, Ill	72

* Recommended for acceptance.

Abstract of bids for improving Hay Lake Channel, Saint Mary's River, Michigan, excavating at Middle Neebish, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on March 23, 1885, *in accordance with advertisement dated February* 21, 1885.

No.	Names and residences of bidders.	Excavating above 20-foot grade; price per cubic yard in bank.	Excavating above 14-foot grade; price per cubic yard in bank.
1	Hickler & Green, Buffalo, N. Y	$2 40	$5 25
2	Charles S. Barker, Sault Ste. Marie, Mich	2 50	2 50
3	Carkin, Stickney & Cram, East Saginaw, Mich	2 98	5 50
4	Chicago Dredging and Dock Company, Chicago, Ill	3 50	....
5	Horatio Truman, Manitowoc, Wis	4 00	....
6	Charles F. Dunbar, Buffalo, N. Y	4 50	6 00
7*	Castle Sutherland, East Saginaw, Mich	5 00	60

* Excavating above 14-foot grade recommended for acceptance.

Abstract of bids for furnishing stationery, &c., for use in improving Hay Lake Channel, Sault Sainte Marie River, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on April 20, 1885, *in accordance with paragraph* 1488, *United States Army Regulations*, 1881.

No.	Names and residences of bidders.	Total.
1*	The Richmond and Backus Company, Detroit, Mich	$28 75
2	The Detroit News Company, Detroit, Mich	30 06
3	James W. Fales, Detroit, Mich	30 41

*Accepted.

Abstract of bids for furnishing ship chandlery, &c., for use in improving Hay Lake Channel Sault Sainte Marie, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on April 27, 1885, *in accordance with paragraph* 1488, *United States Army Regulations*, 1881.

No.	Names and residences of bidders.	Total.
1*	H. D. Edwards & Co., Detroit, Mich	$211 45
2	J. P. Donaldson & Co., Detroit, Mich	222 84

*Accepted.

Abstract of bids for furnishing subsistence stores, &c., for use in improving Hay Lake Channel, Sault Sainte Marie River, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on April 28, 1885, *in accordance with paragraph* 1488, *United States Army Regulations*, 1881.

No.	Names and residences of bidders.	Total.
1*	Hull Brothers, Detroit, Mich	$205 77
2	G. & R. McMillan, Detroit, Mich	207 87
3	David Wallace, Detroit, Mich	217 36
4	J. A. & J. Q. Williams, Detroit, Mich	217 22

* Accepted.

Abstract of bids for improving Hay Lake Channel, Saint Mary's River, Michigan, excavating at Middle Neebish, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on May 13, 1885, *in accordance with advertisement dated April* 23, 1885.

No.	Names and residences of bidders.	Excavating above 20-foot grade; price per cubic yard in bank.	Excavating above 14-foot grade; price per cubic yard in bank.
1	Charles S. Barker, Sault Ste. Marie, Mich	$1 80	$1 80
2*	Hickler & Green, Sault Ste. Marie, Mich	2 20	89
3	James Rooney, Toledo, Ohio.	2 30	90
4	Carkin, Stickney & Cram, East Saginaw, Mich	2 30	1 40
5	Louis P. & James A. Smith, Cleveland, Ohio	2 50	95
6	Christian Schwarz, Fort Howard, Wis	4 97	2 24
7	E. H. French, Toledo, Ohio	5 00	5 00

* Excavating above 14-foot grade recommended for acceptance.

REPORT OF MR. E. S. WHEELER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., July 1, 1885.

COLONEL: I have the honor to submit the following report of operations connected with the improving Hay Lake Channel, Saint Mary's River, Michigan, for the fiscal year ending June 30, 1885.

CONTRACT WITH JOHN HICKLER, DATED FEBRUARY 28, 1883.

This contract has been completed, and a final estimate made. The following are the results:

Total amount excavated, bank measure	cubic yards	291,079
Amount excavated inside the prism of the specifications	cubic yards	161,701.1
Total cost at 72 cents per cubic yard		$116,424 79

The amount as measured in the scow by the contractor exceeded the bank measurement by only 2 per cent.

The slight difference between bank and scow measurement, is, in all probability, caused by the current, which is very rapid, washing away considerable material.

EXPERIMENTAL DREDGING AND BLASTING IN MIDDLE NEEBISH.

Dredge No. 8, belonging to Williams & Upham, with a tug and two dump-scows were employed at $8 per hour. The dredge began work August 18, 1884, and stopped for the season November 15, 1884. During this time it worked $708\frac{38}{60}$ hours, amounting to $5,669.07.

The drill scow was engaged a portion of the time between August 6 and November 12 in blasting. The total cost of the blasting was $3,249.58.

The total amount excavated, scow measurement	cubic yards..	7,963
The cost per cubic yard, scow measurement		$1 15¾

The bank measurement was not entirely completed. The dredge and scows occupied the space from cross-section 666 to cross-section 689, and this was not sounded. It is estimated that in this unsounded area there had been excavated 860 cubic yards, bank measure. Adding this to the amount actually measured in bank makes a total of 6,850 cubic yards, and the cost, bank measure, per cubic yard, $1.34½. The scow measure exceeds the bank measure by 16¼ per cent.

CONTRACT WITH JOHN HICKLER, DATED SEPTEMBER 5, 1884.

This contract is for 19 feet depth of water, 100 feet wide at bottom between cross sections 819 and 943. The contract price is 58 cents per cubic yard, bank measure.

The following estimates have been made:

Estimate for October, 1884	cubic yards..	25,764
Estimate for November, 1884	do....	6,989
Estimate for May, 1885	do....	7,162

The June estimate is not yet completed.

CONTRACT WITH HICKLER & GREEN, DATED MAY 18, 1885.

This contract is for a depth of water of 14 feet between cross-sections 509 and 818.

The contract price is 89 cents per cubic yard.

The contractor has two dredges on this work. No estimate has yet been given.

PRESENT CONDITION OF THE CHANNEL.

The channel is now excavated so as to give a depth of water of 19 feet from the upper end down to cross-section 509, and from the lower end up to cross-section 796, leaving between these two points a space of 2,870 feet undredged. This space is covered by the contract of May 18, 1885.

The dredged channel is 100 feet wide at bottom, except from cross-section 485 to 509, and from cross-section 796 to 819, a total distance of 470 feet, where it has a varying width of from 30 to 90 feet at bottom. Should the present contracts be completed within the specified time there will be at the close of this season a depth of 14 feet of water through the Middle Neebish into Hay Lake.

SURVEY AT LOWER END OF HAY LAKE.

Soundings were taken over an area 14,500 feet long and 400 feet wide, extending from section 0, at the angle at head of Middle Neebish Rapids, up to section 290, in Hay Lake, where the water was 19 feet deep.

The sections were 50 feet apart and soundings taken every 10 feet on each section, making 11,931 soundings.

In June, 1884, two lines of tamarack stakes, 400 feet apart, and consecutive stakes on each line 500 feet apart, were driven with a pile-driver placed on the drill-scow, the position of which was located by theodolite intersections from two shore stations.

Nine men were employed in making this survey after the stakes were driven, viz: One assistant engineer, one sub-inspector, and seven laborers.

The method employed for locating the soundings was as follows: Two side lines, each 500 feet long and three-sixteenths inch in diameter and on which were fastened cedar corks every 50 feet, were stretched between consecutive stakes on the side channel lines. Two small boats, in each of which were two men, were anchored at corresponding corks on the side lines. A coil of ratline, on which was fastened, alternately, cedar corks and flannel tags every 10 feet for 400 feet, was stretched between the side boats, and then the soundings were taken from a third boat with a sounding pole at each tag and cork on the cross-line.

Water-gauge readings were taken quarter hourly at gauge A. We began sounding on July 17, and continued at odd intervals on eleven different days till October 18, 1884.

The continuous stormy weather that prevailed during the season added greatly to the cost of the survey.

All the soundings have been corrected to a uniform water-surface of 20 feet above a grade-line, that is 21 feet below bench-mark A.

The soundings and the surface and grade lines have been platted on cross-section sheets.

The computations have been made for a channel 20 feet deep and 300 feet wide at bottom with side slopes of 2 horizontal to 1 vertical.

The amount of excavation in such a channel is 912,800 cubic yards. It is estimated that this material could be removed at a cost of 15 cents per cubic yard if done in large contracts.

This would make the estimated cost $150,612.

SURVEY AT LITTLE RAPIDS.

Two routes have been proposed for the improvement of Little Rapids. With your approval surveys of both of these routes have been begun. For this purpose a system of triangulation has been carried from Topsail Island down through Little Rapids into Hay Lake. Ten points have been selected and stations built and properly marked with stones. The lines of sight have been cleared and the angles at four stations measured. The central line of one of the routes has been cleared through the wooded islands a distance of about half a mile.

DOCK AT MIDDLE NEEBISH.

A small dock has been built on Neebish Island opposite the cut. It is about 40 feet long and extends out to 6 feet of water. A blacksmith shop has been built near this dock. The cost of the dock and blacksmith shop is $175.47. The land on which the shop and dock stand is owned by the United States and at your request has been withdrawn from sale until after the completion of the Hay Lake Channel.

FITTING OUT.

The quarters' boat Swallow, tug Myra, and small boats have been cleaned, calked, and painted. The drill-scow has been put in complete repair; a large boiler has been put in place of the small one previously used.

A new hall, stairway, and entrance door have been built in the warehouse.

The survey at the lower end of Hay Lake and computations have been done by Assistant Engineer Ripley. The monthly estimates have been made by Assistant Engineers Ripley and Burns.

The experimental dredging by the hour was under the charge of inspectors Common and Reed.

The drill-scow was under the charge of Mr. A. F. Hursley.

Mr. A. F. Hursley resigned his position as captain of the United States tug Myra on the 8th June, 1885.

Very respectfully, your obedient servant,

E. S. WHEELER,
Assistant Engineer.

Lieut. Col. O. M. POE,
Corps of Engineers, U. S. A.

L L 2.

IMPROVEMENT OF SAINT MARY'S FALLS CANAL AND RIVER, MICHIGAN.

This improvement, originally projected to obtain a 16-foot navigation between Lakes Superior and Huron, has been completed accordingly at a cost of $2,405,432.83 to June 30, 1885.

And scarcely had vessels drawing more than 12 feet begun to use the channel before a demand sprung up for a still greater depth.

The commerce using it also increased enormously, until it is now evident that at an early day additional lockage facilities must be supplied to the canal which forms part of the route.

Only 11 per cent. of the freight passing the canal during the season of 1884 was carried in vessels the draught of which would permit the use of the old locks.

The amount of freight passing the canal has increased from 1,567,741 tons during the season of 1881 to 2,874,557 tons in 1884, or in the three years an increase of 1,306,816 tons, or 83⅖ per cent. in the amount of freight actually passing the canal in one season.

Should this rate of increase continue, the present lockage system will be insufficient to pass the commerce long before it can be, in the usual course of appropriations for river and harbor improvement, enlarged to meet the greater demands upon it.

For the fifteen years preceding 1884 the annual increase in the registered tonnage using the canal was comparatively uniform, and averaged about 107,313 tons.

In 1884, however, the increase was 955,578 tons. This increase was alone equal to the entire commerce through the canal from 1855 to 1860—the first five years the canal was in operation—and is well calculated to startle all who feel any interest in the route by lake—between our great Northwest and the sea-board.

It urges, in the strongest way, that the work of preparing to take care of a commerce greater than the present canal and lockage system could accommodate shall be entered upon without delay.

In my annual report for the fiscal year ending June 30, 1884, I submitted a project with estimates of the cost of so much of the work of enlargement as pertains to the canal. (See pages 2011 *et seq.*, Annual Report of the Chief of Engineers for 1884.)

Upon further consideration I am inclined to think the estimate there given is too small, especially in the item for deepening the canal above the locks, and that the total estimate ought to be increased by such amount ($140,915) as will make the grand total $1,750,000.

I also desire to modify the project then presented to such extent as to leave open the question of the dimensions of the lock proposed to be built in place of the present old locks.

I further desire to emphasize the fact that in the proposed enlargement every part of the present work will be utilized *without loss* except the "old locks," and of these a considerable portion of the materials, especially the stone, can be used again.

It is not proposed to disturb the present "new lock," which is all that can be desired for no greater draught than about 17 feet.

When my annual report for 1884 was submitted I was strongly impressed with the necessity for an early commencement upon the new project, but did not fully realize the emergency as it was shown to exist when the statistics of the season's commerce were fully made up.

When that occurred I prepared and submitted my report of January 8, 1885, printed as House Ex. Doc. No. 102, Forty-eighth Congress, second session, of which the following is a copy:

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 14, 1885.

SIR: In the last Annual Report of this office, for the fiscal year ending June 30, 1884, pages 302 and 2011, attention was called to the rapid increase of the commerce passing through the Sault Saint Mary's Canal, being such that, should its rate be maintained for the next eight years, the period would be then reached when the present lockage system would be found insufficient.

To guard against this it was recommended to begin at once the construction of a new lock of large dimensions upon the site of the two old ones.

I have now the honor to submit herewith a copy of a report to this office of the 8th instant, from Lieut. Col. O. M. Poe, Corps of Engineers, in charge, containing official returns lately received of the tonnage passed through the canal during the season of 1884, showing the increase in tonnage to have been beyond all expectation, and so largely in excess of that of previous years that should the rate be maintained (of which there seems to be no doubt) the insufficiency of the present lockage system will be felt at the expiration of one-half the length of time above estimated, or, say, in four years, and indicating beyond question a more urgent necessity for an early commencement of this indispensable work.

In the view of the great importance of this subject, I beg leave to suggest the transmission of this report to the House of Representatives for the information of the Committee on Rivers and Harbors.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

HON. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE.
Detroit, Mich., January 8, 1885.

SIR: In my annual report for the fiscal year ending June 30, 1884,* I submitted a project for the enlargement of Saint Mary's Falls Canal, including the construction of a new lock in place of the two old ones, and urged the matter in terms as strong as seemed proper.

It was stated that the commerce through the canal during 1883 was 2,042,259 tons (registered); that the annual increase in tonnage for fifteen years had been quite uniform, averaging 107,313 tons per year; that only 11 per cent. of the freight passing the canal during 1883 was in vessels of sufficiently light draught to admit of their passing through the old locks, and that if these figures were maintained for eight years the present lockage system, although in constant operation, would be insufficient to take care of the shipping.

We now have complete returns for the season of 1884, and the annual increase in tonnage has not only been maintained but largely exceeded; that is to say, the registered tonnage passing through the canal during the season of 1884 was 2,997,837 tons, an increase of 955,578 tons, or nine times the average annual increase for the preceding fifteen years. Or, to state it possibly with greater force, this *increase* in 1884 is equal to the *entire commerce through the canal during the first five years it was open to navigation.*

Should this rate of increase be maintained, the full capacity of the lockage system will be reached within *four* years instead of *eight*, as estimated in the Annual Report.

The following table affords the means of comparing, in detail, the business of the canal during the season of 1884 with that of 1883:

Comparative statement of the commerce through Saint Mary's Falls Canal, Michigan, for the seasons of 1883 *and* 1884.

Items.	1883.	1884.	Increase.	Per centage.	Decrease.	Per centage.
Vessels .... number..	4,315	5,689	1,374	32	....	....
Lockages .... do....	2,351	3,074	723	31	....	....
Tonnage, registered	2,042,259	2,997,837	955,578	47	....	....
Do .... freight..	2,267,105	2,874,557	607,452	27	....	....
Passengers .... number..	39,130	54,214	15,084	39	....	....
Coal .... tons..	714,444	706,379	....	....	8,065	1
Building stone .... do ...	2,405	6,047	3,642	151	....	....
Copper .... do....	31,024	36,062	5,038	16	....	....
Flour .... barrels..	687,031	1,248,143	561,112	82	....	....
Grain .... bushels..	6,677,025	12,502,894	5,825,869	87	....	....
Iron ore .... tons..	791,732	1,136,071	344,339	43	....	....
Lumber .... feet, B. M..	87,131,000	122,389,000	35,258,000	40	....	....
Pig and manuf'd iron .... tons..	109,910	72,428	....	....	37,482	34
Salt .... barrels..	70,898	144,804	73,906	104	....	....
Silver ore .... tons..	814	9,731	8,917	1,095	....	....
Unclassified freights ..... do....	191,571	207,173	15,602	8	....	....

Canal opened April 23, and closed December 10, 1884, being open to navigation 232 days.
Canal was open during season of 1883, 224 days.

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*Annual Report Chief of Engineers for 1884, Part III, page 2011.

The increase in registered tonnage was 47 per cent.; in grain, 87 per cent.; in flour, 82 per cent., and in iron ore 43 per cent.

These are the great staples (although a notable increase in the lumber traffic was developed), and indicate the direction from which future increase must be expected.

It will be principally from the cereal products of the Northwest, through the systems of railways terminating on Lake Superior.

It is stated in the commercial columns of the newspapers that there are now stored at Duluth alone nearly 5,000,000 bushels of grain, and that this will be increased to more than 7,000,000 by the time navigation opens.

If this be true (and I do not doubt it for a moment), the canal will be pushed toward its utmost during the season of 1885.

But the facts adverted to do more than indicate the necessity for beginning the enlargement of the canal at the earliest date possible. They protest in the strongest possible terms against all propositions to fit the old locks for dry-dock purposes, or to build a dry-dock anywhere in the immediate vicinity of the canal, to be operated in connection therewith.

Another point which I particularly invite attention to is the fact that no portion of the work of enlargement recently completed will be lost. On the contrary, it is just that much done towards the project now so strongly recommended.

I have to request that this report be fowarded for consideration in connection with my annual report for the year ending June 30, 1884.

I am, sir, very respectfully, your obedient servant,

O. M. Poe,
Lieut. Col. of Engineers,
Brt. Brig. Gen., U. S. A.

The Chief of Engineers, U. S. A.

The table in the foregoing document compares the traffic for the two *seasons* 1883 and 1884.

The following table compares the traffic for the *fiscal years* 1883–'84, and 1884–'85:

It brings the comparison down by periods six months later than in the former case, introducing the commerce of the first two months of the current year.

Attention is invited to the great and continued increase in the grain trade. This was foreshadowed in the remark made in the report of January 8, 1885, that in the future the increase will be "principally from the cereal products of the Northwest, through the systems of railways terminating on Lake Superior." I confidently look for a continuance of the increase of this traffic.

Comparative statement of business through Saint Mary's Falls Canal for the fiscal years 1883–'84 and 1884–'85.

Commodities, &c.	1883–'84.	1884–'85.	Increase.	Decrease.
Vessels .... Number..	4,768	5,629	861	....
Lockages .... do....	2,569	3,021	452	....
Registered .... tonnage..	2,333,257	2,981,786	648,529	....
Freight .... do....	2,540,799	2,870,728	329,929	....
Passengers .... number..	49,263	44,533	....	4,730
Coal .... tons..	764,915	691,174	....	73,741
Copper .... do ..	33,536	36,829	3,293	....
Flour .... barrels..	891,291	1,334,802	443,511	....
Grain .... bushels..	7,490,938	14,130,448	6,639,510	....
Iron ore .... tons..	936,107	1,112,828	176,701	....
Manufactured iron .... do ...	93,103	63,083	....	30,020
Lumber .... M feet, B. M..	92,638,000	131,132,000	38,494,000	....
Salt .... barrels..	109,731	129,452	19,721	....
Miscellaneous freight .... tons..	204,451	187,216	....	17,235

Additional statistics of interest in this connection are given in the report on operating and care of Saint Mary's Falls Canal.

Upon a series of sheets hereto attached an endeavor has been made to graphically represent the business of the canal by *calendar* years, from its opening in 1855 to the close of 1884. Sheet No. 1 shows total tonnage; No. 2, coal and copper; No. 3, iron ore; No. 4, lumber; No. 5, grain; No. 6, the passenger traffic.

The five articles of freight above mentioned comprise about six-sevenths of the entire freight.

Fully realizing the necessity and urgency of the case, I recommend an appropriation of at least $250,000 to begin the work of the proposed enlargement of the canal.

A much larger sum could be put under contract immediately upon its becoming available, but if the full amount named be granted the work can be started with vigor preparatory to asking for larger sums annually to continue it.

The improvement, with sufficient appropriations, can be completed in five years from the time of beginning, and I am satisfied that it will be none too soon.

Amount (estimated) required for the proposed project	$1,750,000
Amount that can be profitably expended in the fiscal year ending June 30, 1887	250,000

L L 3.

OPERATING AND CARE OF SAINT MARY'S FALLS CANAL, MICHIGAN.

Saint Mary's Falls Canal is about 1 mile in length. It constitutes a part of the water route between Lakes Huron and Superior, and affords the means of passing the Sault de Sainte Marie, overcoming by its lockage system a difference of level of about 18 feet.

The prism is of variable width and has a depth of 16 feet at the ordinary stage of water.

The lockage system is double, consisting of two locks built when the canal was first constructed, thirty years ago, and now known as the "old locks," and of a single lock completed and opened to navigation September 1, 1881. The latter is known as the "new lock."

The "old locks" consist of two chambers, one immediately up-stream from the other, each 70 feet wide, 350 feet long between gates, and 9 feet lift, calculated for a depth of 12 feet on the miter-sills, but really having only 11½ feet at the ordinary stage.

The "new lock" is 80 feet wide, narrowing to 60 feet at the gates, 515 feet between gates, and has a lift of 18 feet, with 17 feet of water on the miter-sills at the ordinary stage.

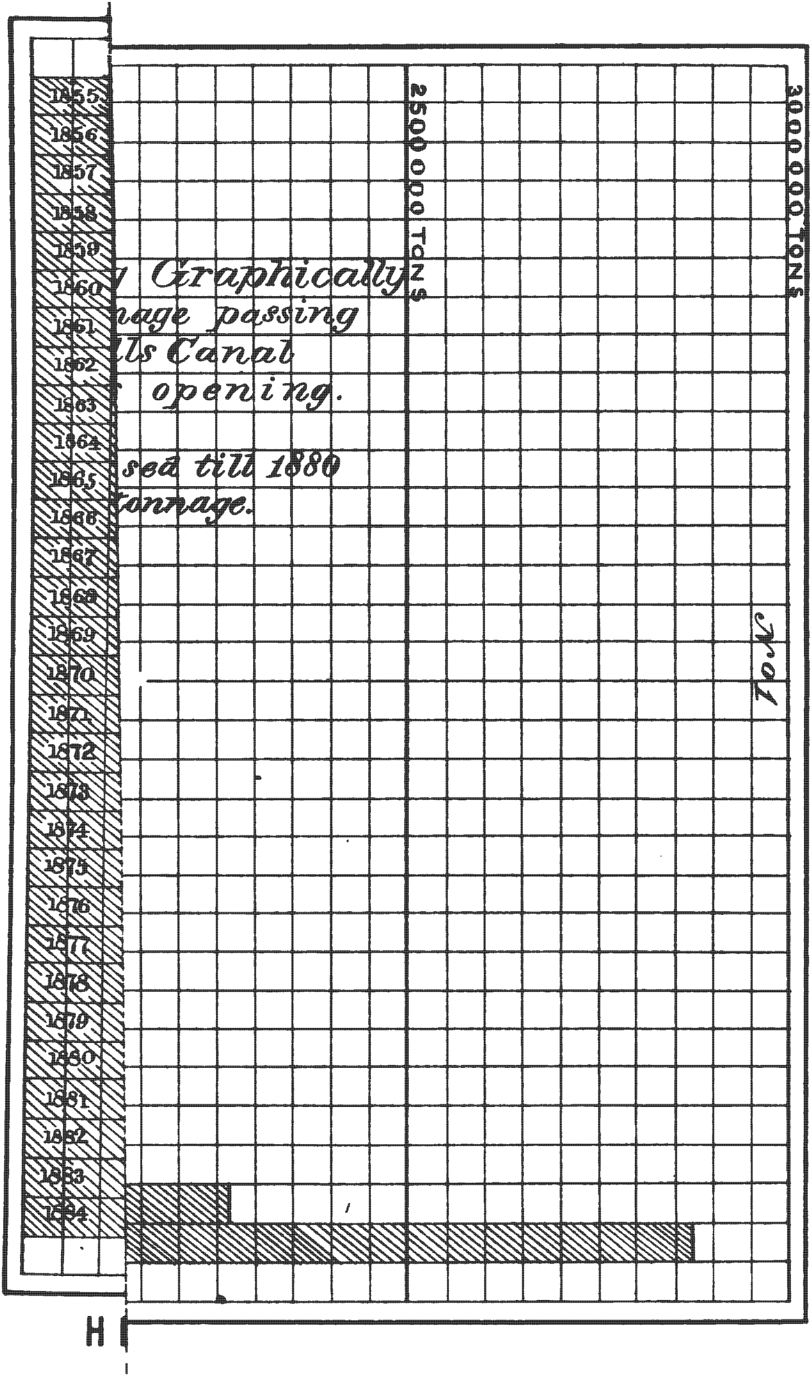
This lock is a magnificent structure, and admirably serves its purpose.

Its operation is rapid, quiet, and efficient, and after an experience of four years there is no improvement of importance to suggest.

The organization of the regular force employed in operating and care was changed on the 1st of April, 1885, by dispensing with the services of one superintendent at a salary of $1,800 per year, and four lockmen at a salary of $45 per month for the season, thus considerably reducing expenses.

The work of passing vessels through the canal has been thoroughly, promptly, and satisfactorily performed. Only trifling derangements have occurred, and these have been quickly repaired, with but little delay to navigation.

Three men belonging to vessels were drowned during the year and another had his leg broken.



Graphically
nage passing
lls Canal
opening.
sea till 1880
tonnage.
2500 000 TONS
3000 000 TONS
1855
1856
1857
1858
1859
1860
1861
1862
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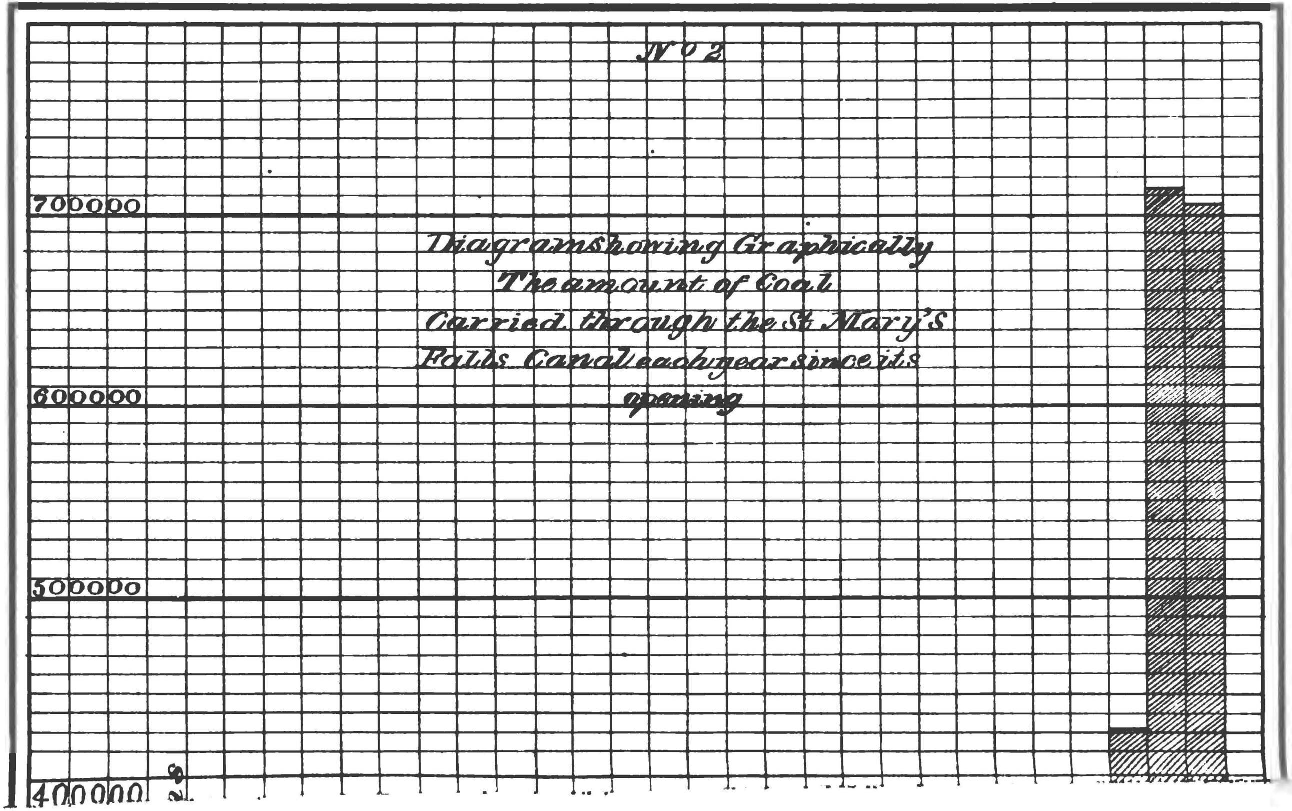
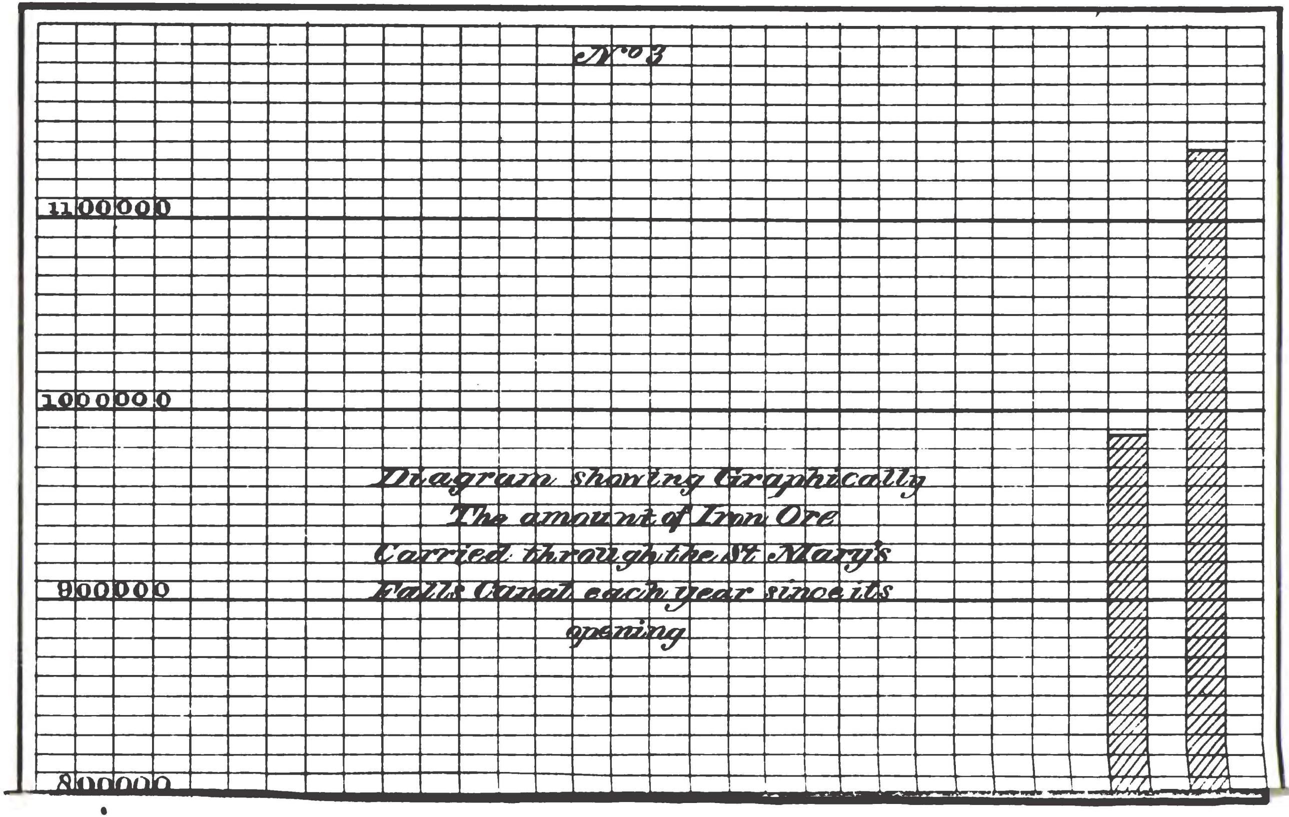


No 2

Diagram showing Graphically
The amount of Coal
Carried through the St Mary's
Falls Canal each year since its
opening



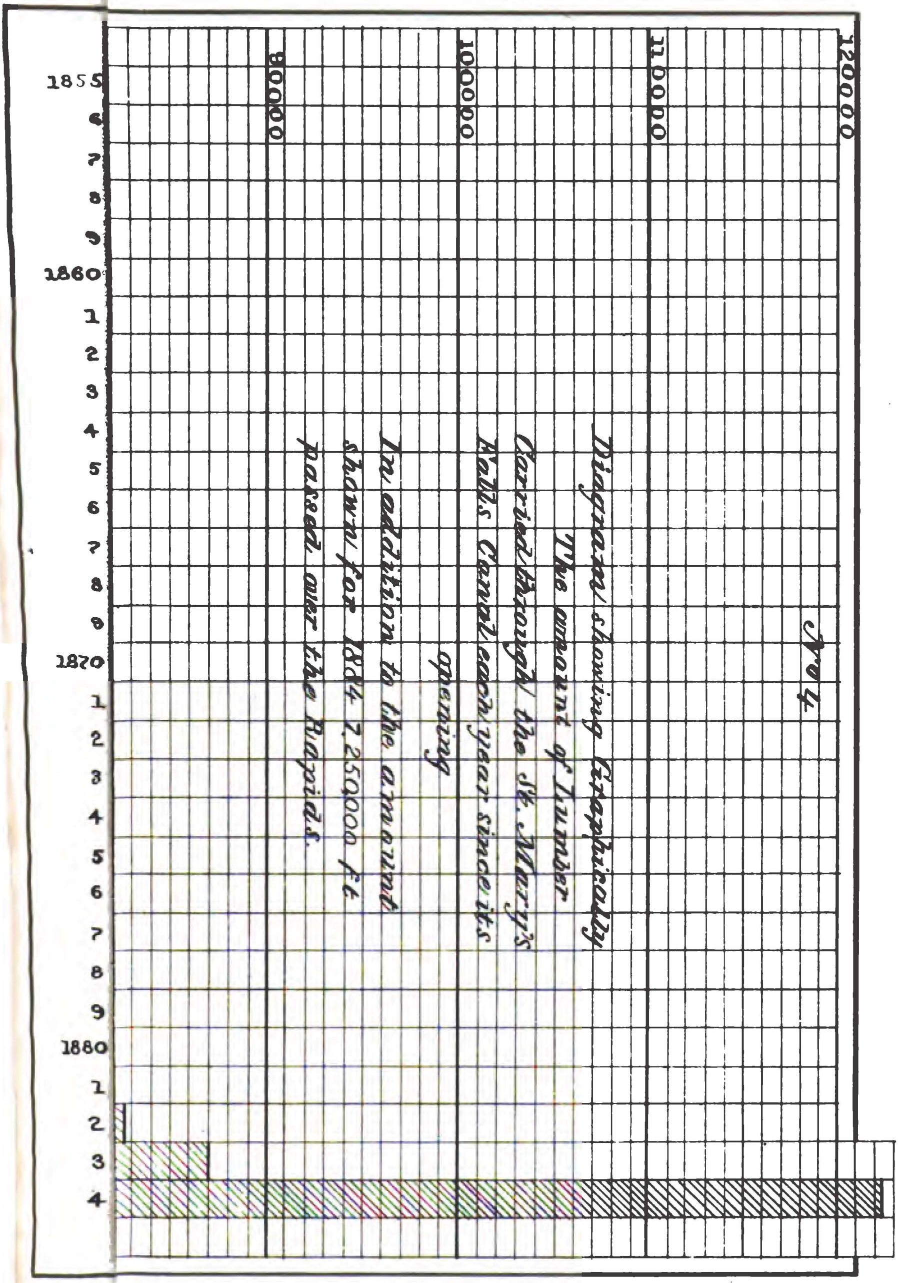
No. 3

Diagram showing Graphically The amount of Iron Ore Carried through the St. Mary's Falls Canal each year since its opening

No 4

Diagram showing Graphically
The amount of Lumber
Carried through the St. Mary's
Falls Canal each year since its
opening

In addition to the amount
shown for 1884 7,250000 ft
passed over the Rapids.



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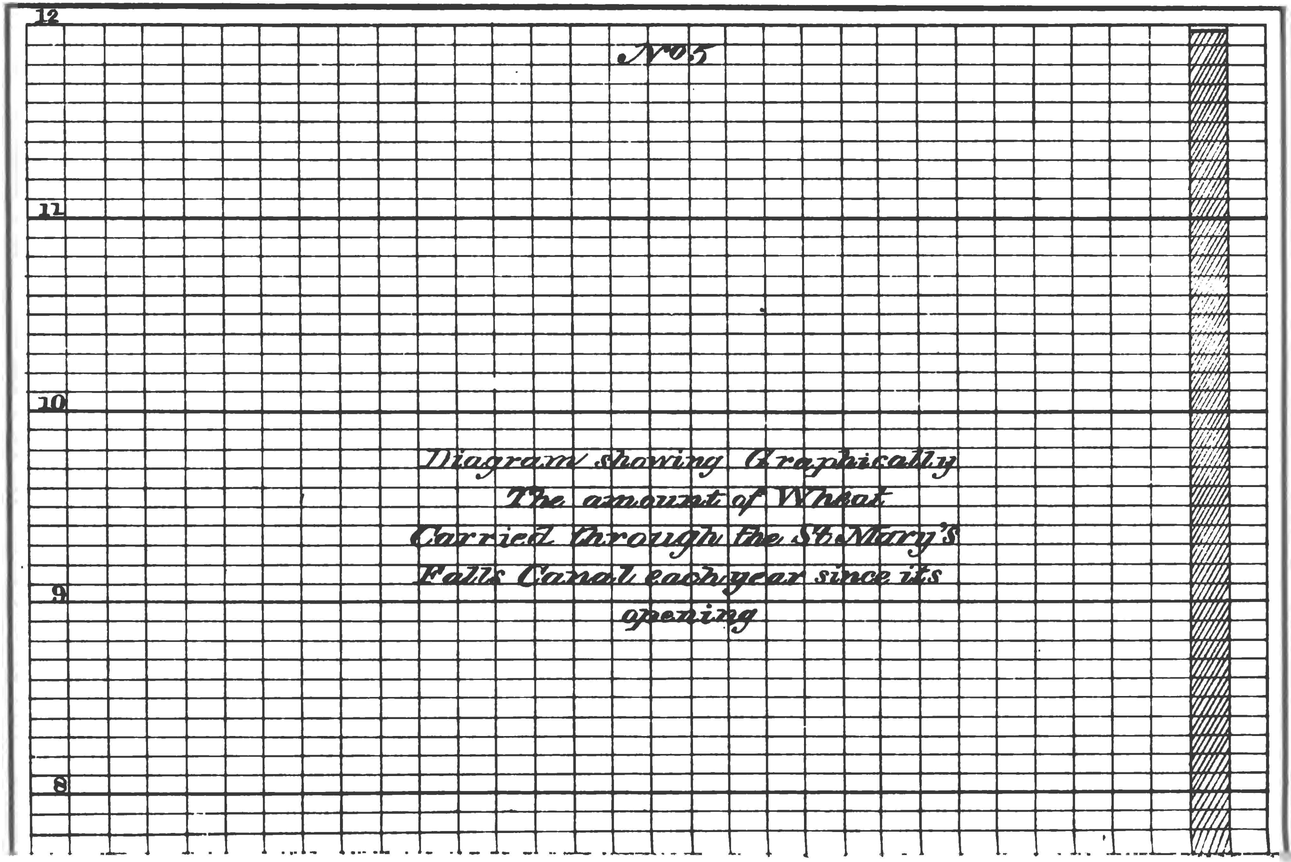
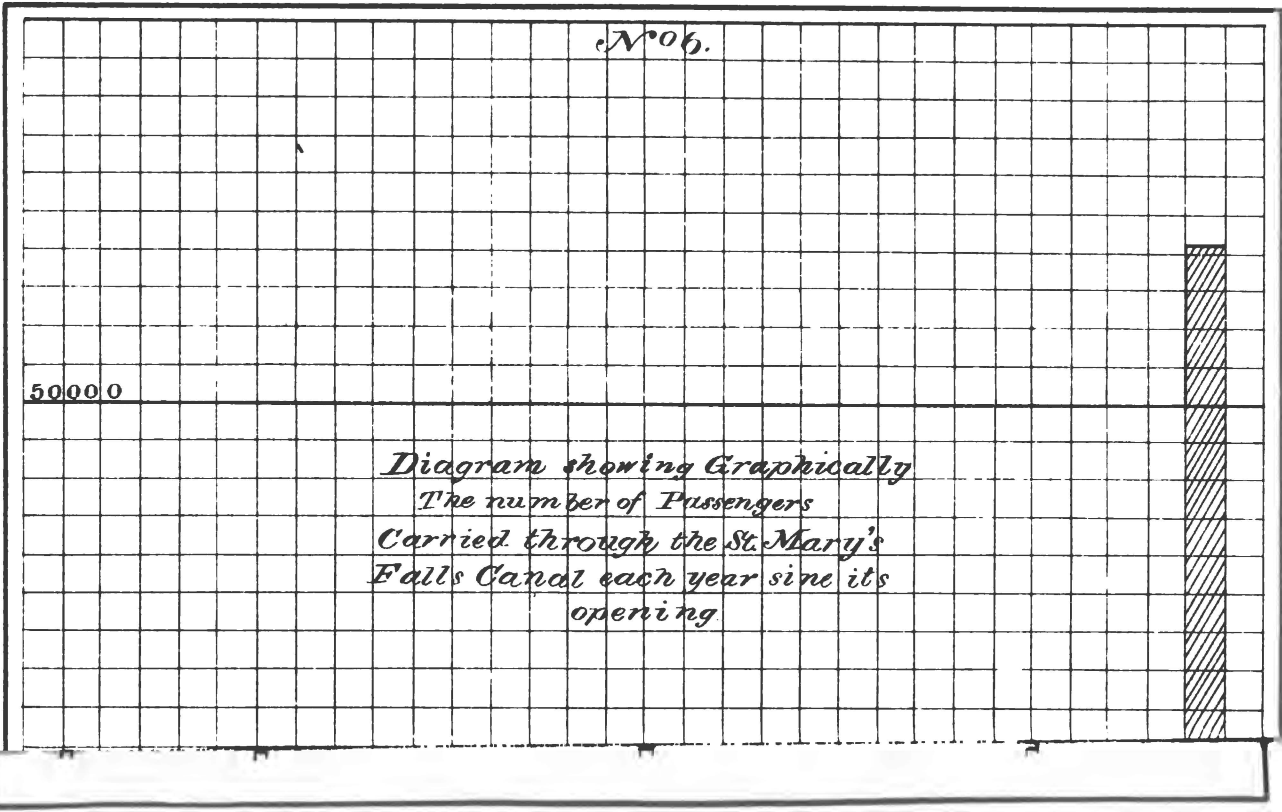


No 5

Diagram showing Graphically
The amount of Wheat
Carried through the St. Mary's
Falls Canal each year since its
opening



N°6.

Diagram showing Graphically
The number of Passengers
Carried through the St. Mary's
Falls Canal each year sine its
opening

The grounds have been much improved, at a cost of $3,473.76.

Electric lights of the arc system have been substituted for the former mineral-oil lamps, with great benefit to all concerned and a considerable saving to the Government.

A portion of the canal grounds between the "old locks" and the river was occupied by Indians, who inhabited twenty-two houses or huts. They were all removed, the ground having been leased to the Michigan fish commission under the provisions of public resolution No. 35, approved June 26, 1884. These Indians were mere squatters, having no legal or equitable right there, but were afforded aid in the removal at a cost of $358.37.

Rules and regulations for the government of the canal were prepared and after approval by the Secretary of War were published in accordance with the provisions of section 7 of the act of Congress approved July 5, 1884.

A complete set of drawings, thirteen in number, illustrating the construction of the canal and locks, has been prepared and photolithographed.

Connected with the canal are 12,000 linear feet of wooden piers, 3,100 linear feet of masonry, one movable dam, fourteen wooden lock-gates, one office, one dwelling-house, one machine-house, two warehouses, one boat-house, one scow, lock machinery, &c., to be cared for and kept in repair. This is done at considerable cost, and, since much of this property is composed of perishable materials, the necessity for repairs and renewals increase with the lapse of time.

Thus far the annual cost has not exceeded one-half of 1 per cent of the whole cost of the work, but it must be expected that in the course of time it may amount to as much as 2 per cent. per annum.

The estimated cost of operating and care during the fiscal year ending June 30, 1885, was $35,000; the actual cost was $27,242.45. The estimated cost of operating and care during the fiscal year ending June 30, 1886, is $32,000, as follows, viz:

Pay-roll of regular force	$17,000
Pay-roll of labor party	9,000
Purchase of supplies	6,000
Total	32.000

All of which is provided for by indefinite appropriation under section 4 of the river and harbor act of July 5, 1884.

The receipts at the canal for the fiscal year 1884–'85 were:

From dry-docking	$346 00
From rents	200 00
Total	546 00
The expenditures were	27,242 45
Net cost of operating and care	26,696 45

The total registered tonnage passing through the canal during the *fiscal* year was	tons..	2,981,786
Total freight tonnage	do...	2,870,728
Number of passengers		44,533
Number of vessels and rafts		5,629

The canal was open to navigation during the fiscal year two hundred and nineteen days, or fourteen days less than during 1883–'84.

It was closed for the winter on December 10, 1884, and opened for the current season May 6, 1885.

The cost per registered ton passing the canal during the fiscal year was eighty-nine one-hundredths of 1 cent, and per freight ton ninety-two one-hundredths of 1 cent.

These items of cost include all repairs and improvements, and all purchases therefor.

The work proposed for the next fiscal year, beyond the actual operating of the canal, consists in continuing the improvement of the grounds, rebuilding such portions of the wooden superstructures as actually need it, and the current repairs. The appended report of Assistant Engineer E. S. Wheeler, general superintendent of the canal, gives in detail the facts above referred to.

An itemized list of expenditures, as required by law, is hereto attached.

REPORT OF MR. E. S. WHEELER, GENERAL SUPERINTENDENT.

OFFICE OF SAINT MARY'S FALLS CANAL,
Sault Sainte Marie, Mich., June 30, 1885.

COLONEL: I have the honor to submit the following report of operations connected with "operating and care of Saint Mary's Falls Canal, Michigan," for the fiscal year ending June 30, 1885:

ORGANIZATION.

The regular force has, by your orders, been diminished by one superintendent and four lockmen. It now consists of John Spalding, superintendent; Andrew Jackson, clerk; Charles H. Spalding and George Reynolds, assistant superintendents; two enginemen, two foremen, four watchmen, and fifteen lockmen, making the total regular force number twenty-seven. The following arrangement of duties has been approved by you:

General superintendent.—Duties: Directs improvements and repairs, makes purchases, &c. Reports to the engineer officer in charge.

Superintendent.—Duties: Has general supervision of canal force; takes actual charge of locking in emergencies. Reports to general superintendent.

Clerk.—Duties: Keeps the books and accounts of the canal; has charge of all office work and the office watchmen. Reports to the superintendent.

Assistant superintendent (morning watch).—Duties: Has charge of regular lock force during morning watch (from 1 a. m. to 1 p. m.); looks after and issues supplies, tools, and other canal property; receives freight from the warehouse, &c. Reports to the superintendent.

Assistant superintendent (afternoon watch).—Duties: Has charge of regular lock force during afternoon watch (from 1 p. m. to 1 a. m.); keeps the time and makes the payrolls for lock force, &c. Reports to the superintendent.

First engineman.—Duties: Has general charge of machine-house and machinery, and special charge of the watches from 7 a. m. to 1 p. m., and from 7 p. m. to 1 a. m. Reports to the assistant superintendent on duty.

Second engineman.—Duties: Has special charge of the machine-house and machinery during the watches from 1 a. m. to 7 a. m., and from 1 p. m. to 7 p. m. Reports to the assistant superintendent on duty.

Foreman (morning watch).—Duties: Takes charge of one side of lock; when not engaged on the lock has charge of the extra lockmen, and does work around the canal; takes charge of diving crew and apparatus, &c. Reports to the assistant superintendent on duty.

Foreman (afternoon watch).—Duties: Takes charge of one side of the lock; when not engaged in locking has charge of labor party, &c. Reports to assistant superintendent on duty.

Office watchmen (two).—Duties: Keep alternate watches in the office; receive reports from masters and clerks, and keep the "Watchman's record." Report to the clerk.

Watchman at the "Head."—Duties: Lives in a small house at the head of the canal; takes the lines of incoming vessels; reads tide-gauge; cares for canal property, &c. Reports to the assistant superintendent on duty.

Night watchman.—Duties: Guards the canal at night; reports approaching vessels; calls lockmen, &c. Reports to the assistant superintendent on duty.

Lockmen (fifteen).—Duties: Passing boats, care of machinery, &c. Report to the assistant superintendent on duty, or to the foreman or engineman to whom they may be assigned.

PASSING OF VESSELS, ACCIDENTS AND DELAYS.

The passing of vessels has been attended to by the regular force. This service has been prompt and efficient. The following accidents and delays have occurred:

On September 10 a sailor from the steam-barge Chamberlain was drowned in the canal just above the locks and another had his leg broken.

On October 25 two men were drowned just below the lock. The lockmen threw life preservers to them and attempted to reach them with poles, but the men were too drunk to help themselves.

On the 21st of July one of the cables which operate the gates was broken. The cable was replaced in six hours. The barge Republic and tow were delayed forty-five minutes.

On the 29th of September another wire cable was broken. Four and a half hours were occupied in replacing it. The propellers Nyack and Canada were each delayed about four hours. This cable was the only new one that has ever been broken in the lock. There seemed to be a current which closed the gate faster than the engine could take in the slack, and the bight caught on the point of the miter-sill.

On the 13th of July the barge Iron State ran into the vessel Our Son, which was moored to the north pier about opposite the movable dam. The damage to both vessels was estimated at $600.

All of these incidents were made the subjects of special reports at the time of their occurrence.

IMPROVEMENT OF GROUNDS.

The stone and other material have been removed from the south side below and placed on the north side above the locks. The warehouse has been moved to the lower end of the canal property. The ground below the slope-wall has been graded, walks constructed, and 520 trees planted. A fountain and pool have been constructed on the lower grade, between the machine-house and the street. The cost of these improvements is $3,473.76.

MOVABLE DAM.

The movable dam has been closed once each month during the season of navigation, and has been kept in complete repair.

ELECTRIC LIGHTS.

The old kerosene lamps have been replaced with electric lights, which were lighted for the first time on the 28th of June, 1884.

The Brush arc light is used. A ten-light dynamo is placed in the machine-house, and is run by the turbines. Six lights are placed in a line along the south wall of the new lock on posts 30 feet high, except one below the lock, which is on a post 48 feet high. One light is placed on the north side of the new lock, one in the office, and two in the machine house. The cost of the plant was $2,021.30. The light has been very easy to care for, is very much better and cheaper than the old lights.

DIVING CREW.

The diving crew has been employed two or three times each month, and has done the work required of it in a satisfactory manner.

SURVEYS CONNECTED WITH THE CANAL.

Survey near movable dam.—In accordance with your instructions a survey of a portion of the canal near the movable dam was made, to show the filling in of soft material since the opening of the canal. There seemed to be very little. A special report of this survey was submitted October 15, 1884, by Assistant Engineer Ripley and party, of the Hay Lake Channel Improvement. The cost was $22.98.

Survey for site for light-keeper's dwelling.—As instructed by you a survey was also made of the canal lands west of Meridian street and south of the canal. This survey showed contour lines 1 foot apart vertically, and covered an area of about 1,000 feet long and 150 feet wide, and was made for the purpose of computing the amount of excavation necessary to prepare a site for light-keeper's dwelling.

Survey of map to accompany report on title to canal lands.—In accordance with your instructions, a report on the title to canal lands west of Portage street has been prepared. To illustrate this report a map was made in the following manner: Points in the United States land survey by Whelpley and in the United States lake survey of the river were occupied last summer, and theodolite pointings taken from one to the other, so as to connect the two surveys by a system of triangulation. The two surveys thus connected were platted in one map. This work was done by Assistant Engineer Ripley.

SCRAP IRON AND OLD ROPE.

A large amount of junk had accumulated about the canal, and was very much in the way. By your order under express authorization of the War Department it was collected, weighed, and sold to John Hickler. The sale amounted to $1,482.18, and the proceeds were turned in to the Treasury.

REMOVAL OF THE INDIANS.

The land lying between the slope-wall of the old locks and the river has been leased to the Michigan State Fish Commission. There were twenty-two Indian houses on this ground and eighteen of them were occupied last fall. On the 27th of September I received your order to remove the Indians. A printed copy of your order was given to each head of a family or owner of house. Two of them, who were employed upon the canal, moved away immediately. In a few days others asked to have their houses moved for them, and this it was deemed best to do, in order to induce better feeling. The regular force was employed at this work at intervals for several weeks. On the 8th of November the last house was removed. The cost of this work was $358.37.

NEW RULES AND REGULATIONS.

The new rules and regulations were received on the 29th of September, and have been enforced since that date.

Copies were posted in conspicuous places in the village, at the canal office, and locks, and in addition, a copy was issued to the master and clerk of each craft passing the canal, and a receipt taken therefor. This plan was adopted to avoid duplicating them to the vessels, and also as evidence that all masters and clerks had been duly informed of the change in the rules for the government of the canal.

The rules and regulations as published by order of the Secretary of War are as follows:

RULES AND REGULATIONS FOR THE GOVERNMENT OF THE SAINT MARY'S FALLS CANAL, MICHIGAN.

In accordance with the provisions of section 7 of the act of Congress approved July 5, 1884.

Rule 1. The movements of all vessels, boats, and other floating things in the canal and locks, shall be under the direction of the superintendent and his assistants.

Rule 2. All steamers desiring to use the locks shall signal for the same by two long and two short blasts of the whistle.

Rule 3. All tows before entering the locks shall, if practicable, shorten their tow-lines to 400 feet or less. All tows leaving the locks shall *invariably* shorten their tow lines to 400 feet or less.

Rule 4. In passing the canal vessels or boats belonging to the United States Government shall have precedence over all others. Passenger boats shall in general have precedence over all others, except those belonging to the United States.

Rafts must give way to all documented craft. Boats arriving first at the canal will in general have precedence over others of the same class. Small vessels or craft bent on pleasure only shall not be granted a separate lockage when others are waiting to pass the locks, but may be passed through the locks in company with other vessels.

Rule 5. All boats waiting above the locks for lockage, must be kept at least 400 feet above the upper gates; and those waiting below the locks must be kept at least 200 feet below the lower gates.

Rule 6. Masters or clerks of vessels or boats shall report in person at the office of the superintendent on each passage, and make such statement of passengers, freight, and registered tonnage as he may require.

Rule 7. No business trading or landing of freight or baggage will be allowed on or over the canal-piers or lock-walls, except such small articles as may be readily carried in the hand, so as not to delay navigation or obstruct the operating of the locks.

Rule 8. Vessels or boats may be moored to the piers only when specially permitted by the superintendent, and then only in such places and for such times as he may direct.

Rule 9. No material of any kind shall be thrown into the canal. Flues shall not be cleaned in the locks.

Rule 10. All persons are prohibited from willfully or carelessly damaging the canal, or any part thereof.

Rule 11. All boats using the canal must be free from projecting irons or rough surfaces that would be liable to damage the lock-walls or canal piers.

Rule 12. No vessel or boat shall in any way obstruct the canal or delay in passing through, unless permitted to do so by the proper authority. The neglecting of any lawful order shall be construed as obstructing the free navigation of the canal.

REPORTS OF FREIGHT AND PASSENGER TRAFFIC.

Statistics relating to freight and passenger traffic are collected from reports furnished by masters and clerks of vessels when passing through the locks. Blanks upon which to make these reports are furnished from this office, and a return of cargo and passengers exacted from each craft.

It has been the custom to issue blanks printed on loose sheets of paper, and it was found that in this form many were wasted. With your approval the blanks are now bound in small books, containing sufficient for twenty-five trips for passenger and freight boats and fifty for tug-boats. These books are issued to the masters or clerks and receipts taken therefor. This plan has proven a great convenience and saving.

DRAWINGS OF CANAL AND LOCKS.

The drawings for publication of canal and locks have been completed by W. C. Sauer, draughtsman. A brief description has been prepared to accompany them.

COST OF OPERATING AND CARE DURING THE PRESENT FISCAL YEAR.

Pay-roll of regular force	$19,146 67
Pay-roll of labor party	4,523 43
Purchase of supplies	3,572 35
	27,242 45
Less receipts for rents and dry-docking	546 00
Net cost of operating and care	26,696 45

ESTIMATED COST FOR NEXT FISCAL YEAR.

Pay-roll of regular force	$17,000 00
Pay-roll of labor party	9,000 00
Purchase of supplies	6,000 00
Total	32,000 00

For my report on the statistics, finances, and business of the canal I append the report of Mr. Jackson, clerk, as compiled by him from the books of his office.

Very respectfully, your obedient servant,

E. S. WHEELER,
General Superintendent.

Lieut. Col. O. M. POE,
Corps of Engineers, U. S. A.

REPORT OF MR. ANDREW JACKSON, CLERK.

OFFICE OF SAINT MARY'S FALLS CANAL,
Sault Sainte Marie, Mich., July 1, 1885.

SIR: I have the honor to make the following report connected with operating and care Saint Mary's Falls Canal, Michigan, for the fiscal year ending June 30, 1885.

The canal was open to navigation during the present fiscal year 219 days, 14 days less than during the fiscal year of 1883–'84. It was closed for the winter on December 10, 1884, and opened for the current season on May 6, 1885.

The statement of business for the season of 1884 shows that five articles, consisting of iron ore, lumber, coal, wheat, and copper comprise 84 per cent. of the entire commerce through the canal for that year. The percentage that each bears to the entire freight traffic is as follows: Iron ore, 40; coal, 24; wheat, 13; lumber, 6, and copper 1 per cent.

Three of these, wheat, coal, and lumber, are comparatively new freights, not having been prominent in the commerce of Lake Superior until recently. The first shipments of wheat and coal in any considerable quantity were in 1871, while lumber shipments did not begin until 1875.

Iron ore and copper have always been important items of the traffic, though they have increased, in the case of the former, from 1,447 tons in 1855 (the year the canal was first opened) to 11,136,071 tons in 1884, and in the latter from 3,196 tons to 36,062 tons during the same period.

The total amount of registered tonnage which has passed through the canal since its first opening in 1855 up to the present date is 29,766,927 tons.

On July 24, 1884, there were 55 passages through the locks, the largest day's business in the history of the canal. On June 12, 1885, there were 53 passages through the new lock. 43 of these were locked between the hours of 11 o'clock a. m. and 12 o'clock midnight, or during thirteen hours of the day. The lock was also idle during this time one hour and thirty-seven minutes.

The statement of business through the canal shows the total freight traffic for the present year to be 2,870,728 tons; this is 329,929 tons greater than the freight tonnage for the last fiscal year.

Statement of receipts and expenditures at Saint Mary's Falls Canal, Michigan, during the fiscal year ending June 30, 1885.

Receipts.		Expenditures.	
Source.	Amount.	For what purpose.	Amount.
Dry-docking	$346 00	Office expenses	$716 09
Rents	200 00	General purchases	1,209 80
		Photolithographing drawings	275 00
	546 00	Repairs	4,111 17
		Labor (operating canal)	16,277 93
		Extra labor	4,496 01
		Lights on locks	156 45
			27,242 45

Net cost of operating, and care of canal, $26,696.45.

Statement of the number of vessels passed through the Saint Mary's Falls Canal, Michigan with number, time, and cost of lockages, for the fiscal year ending June 30, 1885.

Items.	Through old locks.	Through new locks.	Totals and means.
Number of vessels	93	5,536	5,629
Number of lockages	57	2,964	3,021
Registered tonnage			2,981,786
Freight ... tons			2,870,728
Time expended in receiving and passing vessels:			
Per vessel ... minutes	29	19	24
Per lockage ... do	36	36	14½
Time per vessel during which vessels were in lock ... do	43	31	27
Cost:			
Per vessel			$4 69
Per lockage			8 75
Per ton, register			0.0089
Per ton, freight			0.0092

NOTE—"Cost" includes all repairs and improvements made by the operating force and labor party and all purchases therefor.

STATEMENT OF THE BUSINESS OF THE SAINT MARY'S FALLS CANAL, MICHIGAN, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

Number and class of vessels passed:

Side-wheel steamers	140
Propellers	3,421
Sail	1,669
Rafts and unregistered craft	399
Total passages	5,629
Total registered tonnage	2,981,786

Freight and passenger traffic:

Coal	tons	691,174
Copper	do	36,829
Flour	barrels	1,334,802
Grain	bushels	14,130,448
Iron ore	tons	1,112,828
Pig and manufactured iron	do	63,083
Lumber	M feet, B. M.	131,132,000
Salt	barrels	129,452
Miscellaneous or unclassified freight	tons	187,216
Total freight	tons	2,870,728
Passengers	number	44,533

Very respectfully, your obedient servant,

ANDREW JACKSON,
Clerk.

To Mr. E. S. WHEELER,
General Superintendent.

Abstract of bids for supplies for operating and care of Saint Mary's Falls Canal, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on September 23, 1884, *in accordance with circular letter from this office dated September* 17, 1884, *as prescribed by paragraph* 1488, *Army Regulations*, 1881.

No.	Names and residences of bidders.	Hardware, approximate total.	Paints, oils, &c., approximate total.	Rope, &c., approximate total.	Remarks.
1	T. B. Rayl & Co., Detroit, Mich	$153 61			Recommended for acceptance.
2	Charles A. Strelinger & Co., Detroit, Mich.				Incomplete.
3	Buhl, Sons & Co., Detroit, Mich				Do.
4	Standard Bros., Detroit, Mich				Incomplete and not signed.
1	Farrand, Williams & Co. Detroit, Mich.		$421 78		Recommended for acceptance.
2	F. H. Hinchman & Son, Detroit, Mich		439 56		
1	J. P. Donaldson & Co			$971 82	Do.
2	H. D. Edwards & Co			1,016 04	

NOTE.—For the purpose of comparing the bids, the approximate quantities given by each lowest bidder were adopted to obtain the totals of the other bidders.

Abstract of bids for furnishing 14,000 *blank vessel-statements for use in "operating and care of Saint Mary's Falls Canal, Michigan," received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on March* 30, 1885, *in accordance with paragraph* 1488, *United States Army Regulations*, 1881.

No.	Names and residences of bidders.	Total.	Remarks.
1	The Detroit News Company, Detroit, Mich	$55 00	Accepted.
2	Richmond, Backus & Co., Detroit, Mich	63 50	
3	J. W. Fales & Co., Detroit, Mich	77 10	No. 1.
	Do	61 85	No. 2.

Itemized statement of expenditures incurred on account of appropriation for operating and care of Saint Mary's Falls Canal, Michigan, during the fiscal year ending June 30, 1885.

FOR MONTH OF JULY, 1884 (PART).

Date.	No. of voucher.	From whom purchased.	Articles.	Totals.
1884. June 5	3	D. R. Peirce, treasurer.	1 cast-iron pulley, 525 pounds, at 4 cents per pound	$21 00
			2 set screws, at 25 cents each	50
			18½ hours' labor, lathe-work, at 60 cents per hour	11 10
			5 hours' labor, vise-work, at 40 cents per hour	2 00
			7½ hours' labor, common, at 20 cents per hour	1 50
			Cartage on pulley, shop to dock	50
July 11	4	W. W. Leggett, agent.	Packing electric light machinery	2 00

FOR MONTH OF AUGUST, 1884.

Date.	No. of voucher.	From whom purchased.	Articles.	Totals.
July 11	1 and 2	Pay-rolls, July	2 superintendents, at $150 each	300 00
			2 assistant superintendents, at $100 each	200 00
			1 clerk	150 00
			2 foremen, at $75 each	150 00
			1 engineman	90 00
			1 engineman	80 00
			4 watchmen, at $45 each	180 00
			2 lockmen, at $60 each	120 00
			2 lockmen, at $50 each	100 00
			15 lockmen, 14 19/30 months, at $45 each	658 50
			1 laborer, 194½ hours, at 20 cents per hour	38 90
			14 laborers, 3,137½ hours, at 17½ cents per hour	549 05
			2 blacksmiths, 154 hours, at 30 cents per hour	46 20
			1 carpenter, 255 hours, at 25 cents per hour	63 75
			1 scrubber, 40 hours, at 15 cents per hour	6 00
July 2	3	E. D. Johnson	1,153 feet pine flooring (matched), at $18 per M feet	20 79
			Cartage on same from yard to canal	60

FOR MONTH OF SEPTEMBER, 1884.

Date.	No. of voucher.	From whom purchased.	Articles.	Totals.
July 2	1 and 2	Pay-rolls, August	2 superintendents, at $150 each	303 00
			2 assistant superintendents, at $100 each	200 00
			1 clerk	150 00
			2 foremen, at $75 each	150 00
			4 watchmen, at $45 each	180 00
			1 engineman	90 00
			1 engineman	80 00
			2 lockmen, at $60 each	120 00
			2 lockmen, at $50 each	100 00
			15 lockmen at $45 each	675 00
			1 scrubber, 55 hours, at 15 cents per hour	8 25
			1 carpenter, 250 hours, at 25 cents per hour	62 50
			2 teams, 196⅔ hours, at 37½ cents per hour	73 75
			1 mason, 160⅓ hours, at 30 cents per hour	48 10
			1 blacksmith, 211⅓ hours, at 30 cents per hour	63 40
			1 plasterer, 80 hours, at 25 cents per hour	20 00
			1 laborer, 31 hours, at 20 cents per hour	6 20
			14 laborers, 3,095 hours, at 17½ cents per hour	541 63
Aug. 30	3	W. A. Dennis	10 yards cotton cloth, at 10 cents per yard	1 00
			10 yards red flannel, at 35 cents per yard	3 50
28	4	P. M. Church	3 pounds lampblack, at 25 cents per pound	75
			1 file	35
			10 pounds lath nails, at 6½ cents per pound	65
			1 harness buckle	4
Sept. 26	5	R. A. Geary, manager.	1 rubber stamp, 4 lines, at 25 cents per line	1 00
			2 rubber stamps, 2 lines each, at 25 cents per line	1 00
			1 rubber stamp, 1 line	25
30	6	George H. Smith	Hire of one storage room from July 1 to September 30, both dates inclusive, three months, at $100 per year.	25 00

Itemised statement of expenditures incurred on account of appropriation for operating and care of Saint Mary's Falls Canal, Michigan, &c.—Continued.

FOR MONTH OF OCTOBER, 1884 (PART).

Date.	No. of voucher.	From whom purchased.	Articles.	Totals.
1884. Oct. 3	1	Pay-roll, September.	2 superintendents, at $150 each	$300 00
			2 assistant superintendents, at $100 each	200 00
			1 clerk	150 00
			2 foremen, at $75 each	150 00
			1 engineman	90 00
			1 engineman	80 00
			4 watchmen, at $45 each	180 00
			2 divers, 2 days, at $10 per day	20 00
			2 lockmen, at $60 each	120 00
			2 lockmen, at $50 each	100 00
			15 lockmen, 14 14/15 months, at $45 each	672 00
	2	Farrand, Williams & Co.	50 pounds Spanish whiting, at 1 cent per pound	50
			3,000 pounds white lead, at 5½ cents per pound	165 00
			60 gallons turpentine, at 48½ cents per gallon	29 10
			½ dozen No. 1 sash tools, at 32 cents per dozen	16
				7,951 52

Itemised statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, applied to operating and care of Saint Mary's Falls Canal, Michigan, during part of fiscal year ending June 30, 1885.

FOR MONTH OF OCTOBER, 1884 (PART).

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1884.				
	1	Pay-roll, September.	1 team, 10 hours, at 30 cents per hour	$3 00
			1 team, 15 hours, at 37½ cents per hour	5 62
			1 plasterer, 50 hours, at 25 cents per hour	12 50
			1 mason, 10 hours, at 30 cents per hour	3 00
			1 carpenter, 260 hours, at 25 cents per hour	65 00
			1 blacksmith, 156 hours, at 30 cents per hour	46 80
			1 scrubber, 60 hours, at 15 cents per hour	9 00
			1 laborer, 32½ hours, at 20 cents per hour	6 50
			16 laborers, 3,350 hours, at 17½ cents per hour	586 23
Sept. 30	2	E. M. Lacy	2½ pounds glycerine, at 54 cents per pound	1 35
			8 ounces machine oil, at $1.50 per pound	75
13	3	P. M. Church	1 dozen carriage bolts	75
			1 dozen screws	10
			2 pounds umber, at 10 cents per pound	20
16	4	W. A. Dennis	15 yards cotton cloth, at 10 cents per yard	1 50
29	5	George Kemp	30 barrels lime, at $1.25 per barrel	37 50
			Freight and charges from Detroit to Sault Ste. Marie, Mich., on 2 boxes electric light fixtures; 1 box lamp chimneys; 2 boxes carbons; 1 box segments; 1 package printing; 1 bag grass seed—for the lot.	3 71
27	6	K. Tuttle	1 bag (2 bushels) lawn grass seed	5 75
	7	C. Corbett, manager.	Transmission of one telegram from Washington, D. C., to Detroit.	24
	8	Robert D. Perry	4,807 feet B. M. pine lumber, at $12 per M	57 68
Oct. 3	9	T. B. Rayl & Co.	4 cross-cut saws, 28 feet, at 32 cents per foot	8 96
			1 try-square (8 inch)	30
			1 bevel (8 inch)	25
			1 pair 10-inch carpenter's dividers	40
			1 10-inch draw-knife	60
			1 12-inch screw driver	25
			1 wood rasp, half round, 16-inch	50
			1 oil stone	25
			1 iron spoke-shave	20
			1 claw-hammer	35
			1 8-inch monkey-wrench	40
			1 pair tinker's shears	1 75
			1 dozen steel railroad shovels	7 00
			1 ratchet brace and 8 bits	2 85
			1 2-inch millwright's gauge	1 50
			1 1½-inch millwright's gauge	1 00
			1 ¾-inch millwright's gauge	80

Itemized statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH OF OCTOBER, 1884 (PART)—Continued.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1884. Oct. 3	9	T. B. Rayl & Co.	1 set ⅝-inch bolt dies	$1 50
			1 set ¾-inch bolt dies	1 50
			1 pair extension gas-pipe tongs, 1¼-inch to 2-inch	1 00
			1 pair extension gas-pipe tongs, ½-inch to 1-inch	90
			1 tray brass oilers	3 40
			1 speed indicator	1 20
			1 large cutter-wheel	20
			1 small cutter-wheel	15
			1 set grate bars, 3 pieces	6 00
			1 stove fire-pot	2 75
			2 sets mica, at $2 per set	4 00
			1 ash pan	75
			1 stove grate	1 00
			1 set mica	1 25
			6 hammer-handles, at 6 cents each	36
			6 file-handles, at 1½ cents each	09
			2 dozen pick-handles, at $2 per dozen	4 00
			2 dozen ax-handles, at $2.50 per dozen	5 00
			1 cast-iron balance ball, 9-inch diameter	3 50
			2 expansion joints, 10½ inches long, 2½-inch diameter, at $5 each.	10 00
			6 kegs 8-penny nails, $2.50 each	15 00
			6 kegs 12-penny nails, at $2.25 each	13 50
			10 kegs 40-penny nails, at$ 2.25 each	22 50
			10 kegs 60-penny nails, at $2.25 each	22 50
			6 1-inch elbows, at 10 cents each	60
			6 1-inch unions, at 14 cents each	84
			6 ½-inch plugs, at 3 cents each	18
			6 1-inch plugs, at 4 cents each	24
			6 1¼-inch plugs, at 6 cents each	36
			6 2-inch to 1½-inch reducers, at 16 cents each	96
			6 1½-inch to 1¼-inch reducers, at 10 cents each	60
			6 1¼-inch to 1-inch reducers, at 7 cents each	42
	10	T. B. Rayl & Co.	2 brass sleeves, at $4 each	8 00
	11	Farrand, Williams & Co.	50 pounds burnt umber, at 6 cents per pound	3 00
			25 pounds chrome yellow in oil, at 16 cents per pound	4 00
			25 pounds chrome green in oil, at 14 cents per pound	3 50
			5 pounds ultramarine blue, at 20 cents per pound	1 00
			½ pound gold bronze, at $2.25 per pound	1 12
			10 pounds rosin, at 2 cents per pound	20
			5 pounds native shellac, at 26 cents per pound	1 30
			50 pounds putty, at 2½ cents per pound	1 25
			50 pounds red lead, at 5¾ cents per pound	2 88
			4 pounds muriatic acid, at 8¾ cents per pound	35
			4 pounds glycerine, at 28 cents per pound	1 12
			40 gallons Japan dryer, at 77½ cents per gallon	31 00
			10 gallons Dammar varnish, at $1.52½ per gallon	15 25
			10 gallons alcohol, at $2.42½ cents per gallon	24 25
			1 barrel iron-ore paint	4 00
			96 gallons raw linseed oil, at 51 cents per gallon	48 96
			98 4/15 gallons boiled linseed oil, at 54 cents per gallon	53 06
			2 dozen No. 4 super wall brushes, at $4.50 per dozen	9 00
			1 dozen (2 xx round) paint brushes	5 63
			½ dozen No. 8 sash tools, at $1.08 per dozen	54
			½ dozen 6-inch seam brushes, at $1.76 per dozen	88
			1 dozen 9-inch "B" whitewash brushes	3 57
			3 barrels lampblack, at $2.72 each	8 16
Oct. 4	12	R. W. King & Son.	3 dozen No. 1 Argand chimneys, at 50 cents per dozen	1 50
			1 gross wicks	60
			Freight on 1 box chimneys returned from Sault Ste. Marie, Mich.	50

FOR MONTH OF NOVEMBER, 1884.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
Sept. 25	1	Wm. H. Thompson, manager.	Job printing	25 60
	2 and 3	Pay-rolls, October.	2 superintendents, at $150 each	300 00
			2 assistant superintendents, at $100 each	200 00
			1 clerk	150 00
			2 foremen, at $75 each	150 00
			1 engineman	90 00
			1 engineman	60 00
			4 watchmen, at $45 each	180 00
			2 lockmen, at $60 each	120 00
			2 lockmen, at $50 each	100 00
			15 lockmen, at $45 each	675 00

Itemized statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH OF NOVEMBER, 1884—Continued.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1884.				
Sept. 25	2 and 3	Pay-rolls, October.	1 team, 15 hours, at 37½ cents per hour	$5 62
			1 carpenter, 260 hours, at 25 cents per hour	65 00
			1 blacksmith, 107 hours, at 30 cents per hour	32 10
			1 scrubber, 50 hours, at 15 cents per hour	7 50
			15 laborers, 2,882½ hours, at 17½ cents per hour	504 42
Oct. 28	4	George Kemp	30 tons (of 2,000 pounds) anthracite coal, at $6.75 per ton.	202 50
9	5	E. D. Johnson	667 pine shingles, at $3 per M	2 00
			Cartage on same	20
30	6	P. M. Church	2 calking-irons, at 82½ cents each	1 65
			1 pair butts	10
			1 door lock	45
			2 pair of gate hinges, at 35 cents each	70
			2 gate latches, at 15 cents each	30
			1 pair strap hinges	45
			1 gate hook	05
			161 cedar fence-posts, at 7 cents each	11 27
			1 light (16 by 20 inches) window-glass	18
25	7	H. W. Seymour	147 feet, B. M., planed lumber, at $25 per M feet	3 67
			899 feet, B. M., common lumber, at $12 per M feet	10 78
			2,076 feet, B. M., planed lumber, at $16 per M feet	33 21
			242 feet, B. M., planed lumber, at $20 per M feet	4 84
			63 feet, B. M., planed lumber, at $15 per M feet	95
			264 feet, B. M., planed and clear lumber, at $40 per M feet.	10 56
			28 feet, B. M., flooring boards, at $30 per M feet	84
			1,600 fence-pickets, at 2 cents each	32 00
			Cartage on above	2 90
15	8	Charles F. Reed, agent.	Express charges on two packages of field notes from Lansing, Mich., to Detroit, Mich.	50
31	9	George Kemp	Freight and charges from Detroit to Sault Ste. Marie, Mich., on the following articles:	
			2 boxes drugs; 1 box whiting; 1 box dry umber; 1 box putty; 30 kegs white lead; 1 keg red lead; 1 can alcohol; 1 barrel paint; 4 barrels linseed oil; 3 barrels lamp black; 1 barrel charcoal; 3 coils rope; 2 boxes hardware; 1 bundle belting; 6 bales oakum; 10 barrels salt; 2 barrels lard oil; 1 barrel tallow; 4 dozen brooms; 5 boxes soap; 3 cases lye; 5 bales waste; 32 kegs nails; 2 bundles shovels; 2 bundles handles; 1 bundle saws; 10 barrels kerosene oil; 2 cases matches; 4 cans Japan and 1 can Damar varnish; 6 cans turpentine; 1 jug acid; 1 fire-pot; 2 grates; 1 ash pan, and 1 iron balance-ball, weight 21,404 pounds, at 25 cents per hundred-weight.	53 51
			Freight and charges from Detroit to Sault Ste. Marie, Mich., on;	
			1 bundle packing	45
			1 box lamp chimneys	45
			40 feet chain	1 42
			2 barrels iron clamps	1 30
			1 reel wire rope, from Chicago to Sault Ste. Marie, Mich., 2,000 pounds, at 22½ cents per hundred-weight.	4 50
			1 cask glass globes, from Cleveland, Ohio, to Sault Ste. Marie, Mich., 225 pounds, at 46½ cents per hundred-weight.	1 05
			1 reel lead cable, from Ansonia, Conn., to Sault Ste. Marie, Mich.	1
21	10	W. W. Leggett, agent.	20 glass globes, at $1.35 each	27 00
			2 pounds insulated wire, at 50 cents per pound	1 00
			Freight on package wire from Cleveland, Ohio, to Sault Ste. Marie, Mich.	50
			Freight on 1 cask of globes from Sault Ste. Marie, Mich., to Cleveland, Ohio (returned).	3 05
			1 pair small pliers	70
			1 pair medium pliers	90
			1 pair large pliers	1 60
			1 pair pole-climbers	2 25
			1 screw-driver (small)	20
			1 brush (electric light plant)	25
			2,000 copper-coated carbons, at $32.50 per M	65 00
			1 set commutator segments, No. 5	4 00
			1 set brushes, No. 5	2 00
			50 sheets crocus cloth, at 5 cents each	2 50
			½ yard gum cloth, at $1.25 per yard	62

Itemized statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH NOVEMBER, 1884—Continued.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1884. Oct. 21	10	W. W. Leggett, agent.	241 feet lead cable, at 12 cents per foot	$28 92
			50 insulators, at 8 cents each	4 00
			50 knobs, at 7 cents each	3 50
			18 connectors, at 30 cents each	5 40
			3 reels for transporting cable, 2 at $2 and 1 at $2.50	6 50
			Packing globes, &c	2 25
Sept. 26	11	J. P. Donaldson & Co.	2 feet snap-tubing (rubber), at 50 cents per foot	1 00
Nov. 7	12	Andrew Jackson, clerk.	Traveling expenses from Sault Ste. Marie, Mich., to Detroit, Mich.	10 00

FOR MONTH OF DECEMBER, 1884.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
Nov. 30	1	Andrew Jackson	Services as clerk, November, 1884	150 00
Oct. 1	2	J. P. Donaldson & Co.	200 pounds tallow, at 8½ cents per pound	17 00
			1,177 pounds manilla rope, at 14¼ cents per pound	167 72
			20½ pounds marline, at 14 cents per pound	2 87
			317 pounds ⅜-inch chain, at 5 cents per pound	15 85
			2 pounds cotton packing, at 25 cents per pound	50
			32½ pounds square rubber packing, at 32 cents per pound.	10 40
			16 pounds gasket packing, at 20 cents per pound	3 20
			5 pounds candle wicking, at 25 cents per pound	1 25
			528 pounds cotton waste, at 9½ cents per pound	50 16
			96 $\frac{14}{15}$ gallons lard oil, at 60 cents per gallon	58 16
			508½ gallons kerosene oil, at 13 cents per gallon	66 10
			3 cases concentrated lye, at $3 each	9 00
			2 cases matches, No. 9, at $2.70 each	5 40
			5 cases Queen Anne soap, at $5 each	25 00
			1 ½-inch single block	1 20
			1 ½-inch double block	2 25
			2,055 feet ⅝-inch steel wire rope, at 19 cents per foot.	390 45
			100 clamps for wire rope, at 40 cents each	40 00
			2 dust-pans, at 10 cents each	20
			62 feet 7-inch double leather belting, at 89 cents per foot.	55 18
			1 side lace leather	2 50
			1 barrel charcoal	75
			6 bales oakum, at $3.75 each	22 50
			10 barrels salt at $1.20 each	12 00
			4 dozen brooms, at $2 per dozen	8 00
	3 and 4	Pay-rolls, November.	2 superintendents, at $150 each	300 00
			2 assistant superintendents, at $100 each	200 00
			2 foremen, at $75 each	150 00
			1 engineman	90 00
			1 engineman	80 00
			4 watchmen, at $45 each	180 00
			2 lockmen, at $60 each	120 00
			2 lockmen, at $50 each	100 00
			15 lockmen, at $45 each	675 00
			1 mason, 30 hours, at 30 cents per hour	9 00
			1 carpenter, 250 hours, at 25 cents per hour	62 50
			1 blacksmith, 66⅖ hours, at 30 cents per hour	19 92
			1 tinner, 61⅕ hours, at 25 cents per hour	15 30
			1 scrubber, 50 hours, at 15 cents per hour	7 50
			1 laborer, 25 hours, at 17½ cents per hour	4 37
			1 team, 7½ hours, at 37½ cents per hour	2 81
Nov. 29	5	P. M. Church	1 light 8 by 10 inches window glass	05
			1 pair butt hinges	13
			2 sets gate latches and hinges, at 50 cents per set	1 00
			1 pair strap hinges	32
			1 hook	05
			1 package zinc points	15
			22 lights 16 by 30 inches window glass, at 36 cents each	7 92
			2 thumb latches, at 10 cents each	20
			1 pair butt hinges	10
19	6	E. M. Lacy	1 quart Arnold's writing fluid	75
Nov. 10	7	C. H. Chapman & Co.	500 blank vessel-statements	1 25
Dec. 31	8	Andrew Jackson	Services as clerk for month of December 1884	150 00
	9	George H. Smith	Hire of store-room in Detroit, three months, at $100 per year.	25 00

Itemized statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH OF JANUARY, 1885.

Date.	No. of vovchet.	From whom purchased.	Articles.	Total.
1884. Dec. 31	1	Pay-roll, December, 1884.	2 superintendents, at $150 each	$300 00
			2 assistant superintendents, at $100 each	200 00
			1 engineman	90 00
			1 engineman, 10 days, at $80 per month	26 67
			2 foremen, 20 days, at $75 per month	50 00
			4 watchmen, 2 months, at $45 per month	90 00
			2 lockmen, 20 days, at $60 per month	40 00
			2 lockmen, 20 days, at $50 per month	33 34
			15 lockmen, 4 months and 29½ days, at $45 per month	224 25
			1 diver, ½ day, at $10 per day	5 00
1885. Jan. 9	2	P. M. Church	1 drip-pan	30
13	3	Charles F. Reed	Express charges on lockage register from Sault Ste. Marie to Detroit. Mich.	1 10
21	4	W. W. Leggett, agent.	12 cut-out armatures (complete), at $1.10 each	13 20
			Express charges on same from Cleveland, Ohio, to Detroit, Mich.	25
	5	Pay-roll, January, office superintending engineer.	2 clerks, at $175 each	350 00
			1 clerk	100 00
			1 copyist	35 00
			1 messenger	50 00
			1 scrubber, 2 days, at $1 per day	2 00
31	6	Andrew Jackson	Services as clerk for month of January, 1885	150 00

FOR MONTH OF FEBRUARY, 1885.

	1	Pay-roll, January, 1885.	2 superintendents, at $150 each	300 00
			2 assistant superintendents, at $100 each	200 00
			1 engineman	90 00
			1 watchman	45 00
Feb. 28	2	Andrew Jackson	Services as clerk for month of February, 1885	150 00

FOR MONTH OF MARCH, 1885.

Feb. 28	1	Pay-roll, February, 1885.	2 superintendents, at $150 each	300 00
			2 assistant superintendents, at $100	200 00
			1 engineman	90 00
			1 engineman, 20 days, at $80 per month	53 33
			1 foreman, 9 days, at $75 per month	22 50
			2 watchmen, 1 month and 16 days, at $45 per month	69 00
			2 lockmen, 29 days, at $60 per month	58 00
			1 lockman, 9 days, at $45 per month	13 50
	2	J. H. Green	59$\frac{9}{10}$ hours' blacksmith work, at 30 cents per hour	17 97
Feb. 23	3	P. M. Church	1 set grindstone fixtures	75
			1 brass water faucet	65
			4⅛ pounds strap hinges, at 10 cents per pound	41
			1 lock	60
Mar. 31	3	Andrew Jackson	Services as clerk for month of March, 1885	150 00
	4	George H. Smith	Rent of storage room from January 1, 1885, to March 31, 1885, three months, at $100 per year.	25 00

FOR MONTH OF APRIL, 1885.

Apr. 3	1	Pay-roll, March, 1885.	2 superintendents, at $150 per month	300 00
			2 assistant superintendents, at $100 per month	200 00
			1 engineman	90 00
			1 engineman, 14 days, at $80 per month	37 33
			1 lockman, 14 days, at $60 per month	28 00
			1 watchman	45 00
Mar. 14	2	Charles F. Reed, agent.	Freight on drawings from Detroit, Mich., to Washington, D. C.	1 30
Apr. 21	3	J. A. Marsh, treasurer.	10,000 blank vessel-statements bound in books of 25, at $4 per M.	40 00
			4,000 tug-statements bound in books of 50, at $3.75 per M.	15 00

Itemized statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH OF APRIL, 1885—Continued.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1885. Apr. 22	4	Harmon De Graff, treasurer.	1 index book	$0 75
			2 boxes pens (Isaacs), at $1.50 each	3 00
22			2 dozen sheets blotting-paper, at $1 per dozen	2 00
			1 stamp ribbon	1 00
			1 dozen time books (small)	2 00
			2 quarts paste, at 10 cents per quart	20
30	5	Andrew Jackson	Services as clerk, April 1 to 30, inclusive, 1 month	150 00

FOR MONTH OF MAY, 1885.

Apr. 30	1 and 2	Pay-roll, April	1 superintendent	150 00
			2 assistant superintendents, at $100 each	200 00
			1 engineman	90 00
			1 engineman	80 00
			2 foremen, at $75 per month	150 00
			4 watchmen, 3½ months, at $45 per month	157 50
			2 lockmen, at $60 per month	120 00
			2 lockmen, at $50 per month	100 00
			11 lockmen, at $45 per month	495 00
			1 team, 30 hours, at 37½ cents per hour	11 25
			1 blacksmith, 195½ hours, at 30 cents per hour	58 65
			1 carpenter, 40 hours, at 25 cents per hour	10 00
			1 tinner, 4 hours, at 25 cents per hour	1 00
Mar. 30	3	E. S. Wheeler	Traveling expenses from Detroit to Sault Ste. Marie, Mich.	20 40
Apr. 14	4	H. W. Seymour	507 feet, B. M., pine plank, at $12 per M	6 08
			Cartage on same	30
			2 bunches lath, at 10 cents each	20
			500 lath, at 20 cents per 100	1 00
			Cartage on same	15
29	5	P. M. Church	6 bolts, $\frac{7}{16}$-inch, at 50 cents per dozen	25
			5 yards duck, at 28 cents per yard	1 40
			1 pound copper tacks	65
			1 dozen screw-hooks	10
			1½ pounds solder, at 30 cents per pound	45
May 19	6	Brady & Co	Freight and charges from Sault Ste. Marie to Detroit, Mich., on one box negatives.	45

FOR MONTH OF JUNE, 1885.

30	1 and 2	Pay-roll, May	1 superintendent	150 00
			2 assistant superintendents, $100 each	200 00
			1 clerk	150 00
			2 foremen, at $75 each	150 00
			1 engineman	90 00
			1 engineman	80 00
			2 watchmen, at $50 each	100 00
			2 watchmen, at $45 each	90 00
			2 lockmen, at $60 each	120 00
			2 lockmen, at $50 each	100 00
			11 lockmen, 10$\frac{13}{30}$ months, at $45 per month	469 50
			2 divers, one-half day each, at $5 per day	10 00
			1 plasterer, 220 hours, at 25 cents per hour	55 00
			2 teams, 130 hours, at 37½ cents per hour	48 75
			1 carpenter, 270 hours, at 25 cents per hour	67 50
			1 blacksmith, 220 hours, at 30 cents per hour	66 00
			1 tinner, 7 hours, at 20 cents per hour	1 40
			1 scrubber, 80 hours, at 15 cents per hour	12 00
			14 laborers, 2,533 hours, at 17½ cents per hour	443 50
20	3	George Kemp	3 barrels lime, at $1.25 each	3 75
			1,000 shingles	2 75
			Freight on 750 pounds public property from Detroit to Sault Ste. Marie, Mich., at 20 cents per 100 pounds.	1 50
30	4	P. M. Church	2 pairs butts, at 7 cents per pair	15
			2 locks, at 35 cents each	70
			1 door-catch	10
			3 knobs, at 3 cents each	09
			2 dozen C. and H. hooks, at 30 cents per dozen	60
			2 papers tacks, at 8 cents each	16
			1 light (24 by 34 inches), window glass	1 03

Itemized statement of expenditures on account of appropriation for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH OF JUNE, 1885—Continued.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1885.				
May 30	4	P. M. Church	½ pound English vermilion, at 70 cents per pound	$0 35
			3 ounces oil vitriol, 45 cents; and bottle, 5 cents	50
			½ pint sweet oil, at $1.70 per pint	85
			½ pound rotten-stone, pulverized, at 30 cents per pound.	15
			1 door-knob	20
			1 pair butts	13
			10 pounds nails, 4-penny, at 4½ cents per pound	45
			2 pairs butts, at 8 cents per pair	16
			1 lock knob	50
			1 catch	10
			2 latches, at 12½ cents each	25
			2 yards oil-cloth, at 35 cents per yard	70
			2 feet chain, at 15 cents per foot	30
22	5	Robert D. Perry, agent.	107 feet, B. M., pine lumber, 2 by 4 inches, at $12 per M.	1 28
			600 feet, B. M., pine lumber, 2 by 4 inches, at $10 per M.	6 00
			4,000 feet, B. M., pine lumber, 2 by 4 inches, at $12 per M.	48 00
			341 feet, B. M., pine lumber, 2 by 4 inches, at $12 per M.	4 00
1	6	James Rutherford.	12 negatives illustrating the work of construction, &c., at Saint Mary's Falls Canal, Michigan, for an agreed price of.	50 00
12	7	Charles F. Reed, agent.	Express charges on 12 negatives from Detroit, Mich., to Washington, D. C.	90
	8	C. S. Turner	Cartage of public property from United States engineer office, Detroit, Mich., as follows:	
2			To Lake Huron steamer dock (single horse load)	50
7			To Lake Superior steamer dock (double team load)	1 00
14			To Lake Superior steamer dock (single horse load)	50
28	9	H. W. Seymour	450 feet pine flooring, at $30 per M	13 50
			50 feet pine boards (planed), at $40 per M	2 00
			12 feet hand rail, at 3 cents per foot	36
			28 feet 1¼ cove, at 1 cent per foot	28
			60 feet 1½ molding, at 1 cent per foot	60
			46 feet 2½ molding, at 1½ cents per foot	69
			96 feet ½-foot cove, at ½ cent per foot	48
			200 feet oak flooring, at $35 per M	7 00
			60 feet, B. M., pine lumber, ½-inch, at $20 per M	1 20
			150 feet ceiling, at $35 per M	5 25
			100 feet siding, at $20 per M	2 00
			536 feet, B. M., pine lumber (assorted), at $12 per M.	6 43
			100 feet, B. M., pine lumber (planed), at $30 per M	3 00
			50 feet, B. M., pine lumber boards	80
			1 door (pine)	2 00
			Cartage on above, mill to canal	85
June 17	10	P. M. Church	3 yards oil-cloth, at 35 cents per yard	1 05
			6 dozen brass-head tacks, at 3 cents per dozen	18
			6 gate latches, at 20 cents each	1 20
			6 pairs hinges, at 15 cents per pair	90
			1 gate hook	05
			2 hay rakes, at 50 cents each	1 00
			20 yards cotton cloth, at 9 cents per yard	1 80
			5 yards flannel cloth, at 40 cents per yard	2 00
			21½ pounds Babbitt metal, at 12½ cents per pound	2 68
5	11	H. W. Seymotr	14 pieces 4 by 4 inches by 14 feet; 30 pieces 2 by 10 inches by 16 feet (1,061 feet, B. M., pine lumber), at $12 per M.	12 73
			50 feet, B. M., planed pine boards, at $30 per M	1 50
			100 round top fence-pickets, at 2½ cents each	2 50
			6 cedar fence-posts, at 10 cents each	60
			10 pieces 2 by 4 inches by 16 feet planed boards, 107 feet, at $16 per M.	1 71
			Cartage on above, mill to canal	70
30	12	George H. Smith	Rent of one storage room in Detroit, Mich., from April 1 to June 30, 1885 (both dates inclusive), being three months, at $100 per year.	25 00

Itemized statement of expenditures on account of appropriations for operating and care of canals and other work of navigation, &c.—Continued.

FOR MONTH OF JULY, 1885.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1885. June 22	1	Norris Peters	For photolithographing and printing 500 copies each of 14 sheets, of detail drawings of Saint Mary's Falls Canal and locks.	$275 00
30	2 and 3	Pay-rolls, June	1 superintendent	150 00
			2 assistant superintendents, at $100 per month	200 00
			1 clerk	150 00
			1 engineman	90 00
			1 engineman	80 00
			2 foremen, at $75 per month	150 00
			2 watchmen, at $50 per month	100 00
			2 watchmen, at $45 per month	90 00
			2 lockmen, at $60 per month	120 00
			2 lockmen, at $50 per month	100 00
			11 lockmen, 10 months and 25½ days, at $45 per month	488 25
			1 carpenter, 260 hours, at 25 cents per hour	65 00
			1 team, 45 hours, at 37½ cents per hour	16 87
			1 scrubber, 50 hours, at 15 cents per hour	7 50
			1 blacksmith, 172½ hours, at 30 cents per hour	51 75
			1 tinner, 6 hours, at 20 cents per hour	1 20
			15 laborers, 3,455 hours, at 17½ cents per hour	604 60
				19,290 93

RECAPITULATION.

Expended from appropriation for operating and care of Saint Mary's Falls Canal, Michigan	$7,951 52
Expended from appropriation for operation and care of canals and other works of navigation, applied to operating and care of Saint Mary's Falls Canal, Michigan	*19,290 93
	27,242 45

*Includes June pay-rolls and amount paid Peters paid in July.

L L 4.

DRY-DOCK AT SAINT MARY'S FALLS CANAL, MICHIGAN.

With my report for the fiscal year ending June 30, 1884, I presented a full report upon this subject, which was printed at pages 2030 *et seq.* of the Annual Report of the Chief of Engineers for that year. I endeavored to show why a dry-dock should not be built and operated in direct connection with the canal, but suggested that one might be built at or near the east end of the area transferred from the Fort Brady military reservation to the canal reservation.

The river and harbor act of July 5, 1884, directed that certain examinations be made at the canal in connection with this question, and that certain reports, with plans and estimates, be prepared, including the proposed alteration of the old locks to fit them for dry-dock purposes. Except so much as relates to the alteration of the old locks, all the information called for is to be found in the printed report already referred to, and it is supposed to be unnecessary to repeat it.

The following report* was submitted by me in obedience to the requirements of the act of July 5, 1884.

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* For report see Appendix L L 19.

In accordance with the statement contained in the closing paragraph of the report of November 13, 1884, I have caused to be made a plan with specifications for so modifying the upper chamber of the old locks (of 1855) as to fit it for dry-dock purposes, together with an estimate of the probable cost of doing so. They are transmitted herewith.

Perhaps I have performed my whole duty in submitting these various plans and estimates, but I am so anxious lest something should be done that would interfere with the operation of the lockage system, that I venture to repeat the often-expressed opinion that on no account should this transformation of the old locks be made, nor should a dry-dock be built in such immediate connection with the locks or canal as to embarrass their operation. If anything is done by the General Government, the dry-dock should be located where there can be no possible danger of such embarrassment, and I have pointed out how this may be done.

Amount (estimated) required for completion of existing project..........	$323,872 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	150,000 00

Which should be added to the $65,000 (more or less) which, it is understood, the State of Michigan holds in readiness to transfer to the United States for the purpose of constructing a dry-dock at Saint Mary's Falls Canal.

LETTER OF MR. E. C. BURNS, ASSISTANT ENGINEER.

DETROIT, MICH., *April* 28, 1885.

COLONEL: I have the honor to transmit herewith an estimate of the cost of transforming the upper chamber of the old locks of the Saint Mary's Falls Canal, so that it can be used as a dry-dock. Also, general specifications covering the work to be done.

The estimate provides for doing the work in such a manner that vessels of 16-feet draught of water can be docked.

Should it be judged best to limit the draught of vessels to the present depth of the old canal, 12 feet, a saving of about $30,000 would be made in the cost of doing the work.

Very respectfully, your obedient servant,

E. C. BURNS.

Lieut. Col. O. M. POE,
Corps of Engineers, U. S. A.

SPECIFICATIONS FOR TRANSFORMING UPPER CHAMBER OF OLD LOCKS INTO A DRY-DOCK.

GENERAL DESCRIPTION.

The work to be done consists in cutting down the upper miter-wall and head-wall, and in excavating the bed of the old canal above the locks so as to give a clear depth of 16 feet of water; building a removable dam at the foot of the lock; building a pump well and connecting culvert; building a new set of gates for the head of the lock; furnishing pumping machinery and building house for same, and in rebuilding pier revetment above the lock for a distance of about 240 feet on either side of the canal.

MITER AND HEAD WALLS.

Miter and head walls to be cut down about 4 feet, and the upper courses remaining in to be rebuilt, if the same shall be deemed necessary.

GATE RECESSES AND HOLLOW QUOINS.

The face stone in gate recesses and hollow quoins below the present level of miter-sill to be smoothly dressed, and made to conform to the lines of the masonry above that level, to such a depth as the increased height of gate renders necessary.

PUMP WELL AND CULVERT.

Pump well to be 6 feet in diameter; walls to be 3 feet thick, of cement concrete coped with stone; bottom of well to be of concrete not less than 2 feet thick; floor of well to be not less than 3 feet below lock floor.

Culvert to be 4 feet by 4 feet 10 inches in completed section; to be capped with stone not less than 2 feet thick, well bonded into lock-walls. In excavating through lock-wall for culvert great care must be used and sides of excavation left smooth. If deemed necessary the excavation for culvert must be of sufficient width so that the side walls of culvert can be built up in a good and substantial manner.

REMOVABLE DAM.

Dam will be built as shown on drawing. All timber to be of good, sound white pine free from imperfections. Framing to be done in the best manner. Bottom timbers of dam to be well bolted to lock floor. All removable parts to be neatly dressed. Recesses to receive ends of dam to be cut in the masonry as shown.

GATES AND SILL.

Gate to be built after the general plan of those now in use. All timber of the best white oak. All iron work to be of the best quality. Dimensions to conform to drawings to be furnished.

Miter-sill to be oak. Miter wall to be capped with 12 inches by 12 inches timber bolted through to the solid rock. A course of 3-inch planking then laid on upon which the miter-sill will rest. Miter-sill to be well bolted to the underlying timbers.

EXCAVATION.

The material to be excavated consists of earth and bowlders in unknown proportions. The cross-section of excavation to conform to the section of the improved canal. The work must be so done as to give a clear depth of 16 feet of water.

PIER REVETMENT.

Pier revetment will be of the same design and built in the same manner as the revetment of the improved canal.

PUMP AND PUMPING MACHINERY.

Pump to be a centrifugal pump of approved make, capable of pumping 10,000 gallons a minute to a height of 30 feet; to be provided with suitable inlet and discharge pipes and the necessary valves and fittings.

Engine and boiler to be of sufficient power to obtain the required duty from the pump without crowding

Engine house for inclosing engine boiler and pump will be of brick, with iron roof, to be built in accordance with plans to be furnished.

KEEL BLOCK TIMBERS AND BILGE BLOCK WAYS.

Keel block timbers will be of three pieces of 12 inches by 12 inches pine timber placed side by side through the center of the lock and bolted to the lock floor.

Bilge block ways will be of 10 inches by 12 inches, timber laid about 12 feet apart and well bolted to lock floor; with channel to receive bilge block steps in either side, and provided with a suitable racking well spiked on.

SHORE RESTS.

Rests or steps, to receive the ends of shores used in supporting vessels, will be cut in the lock walls; to be placed as directed, and will be in number about three to each 12 linear feet of wall.

DRAINAGE.

The contractor will be required to build the necessary coffer-dams to keep the works free from water, and to remove the same upon completion of the work.

FINALLY.

The contractor will be obliged to furnish all of the workmanship and materials required for the completion of the work, and must make his work conform to the drawings which will be furnished him, which drawings shall form part part of these specifications, and to the directions of the engineer officer in charge.

ESTIMATE OF COST OF TRANSFORMING UPPER CHAMBER OF OLD LOCKS INTO A DRY-DOCK.

Removing miter and head walls and stone cutting and setting stone:	
Removing 155 cubic yards stone-work, at $2	$310
400 square feet stone cutting, at $1	400
80 cubic yards stone reset, at $10	800
	1,510
Removable dam:	
4,625 feet, B. M., of timber and plank, at $40	185
350 pounds of iron (bolts and spikes), at 6 cents	21
Stone cutting (recesses at ends of dam)	44
	250
Gates and sills:	
Estimated	10,000
Excavation above locks:	
5,000 cubic yards, at $1	5,000
Pier revetment:	
480 linear feet, at $50	24,000
Pump well, culvert, and drainage sluice:	
1,350 cubic yards excavation, at 40 cents	540
96 cubic yards concrete masonry, at $10	960
1,200 cubic yards back filling, at 25 cents	300
100 linear feet of paved sluice, at $3.25	325
15 linear feet culvert (tunneled), at $25	375
	2,500
Pumping machinery, house, &c.:	
Estimated	12,000
Keel block timbers and bilge block ways:	
21,000 feet, B. M., timber, at $40	840
1,600 pounds drift-bolts, at 6 cents	96
11,280 pounds cast-iron racking and spikes, at 5 cents	564
	1,500
Shore rests:	
300 shore rests, at $1	300
Drainage:	
Drainage during construction	5,000

RECAPITULATION.

Removing miter and head walls, stone cutting about gate recesses and resetting stone	$1,510
Removable dam	250
Gates and sill	10,000
Excavation above locks	5,000
Pier revetment	24,000
Pump well, culvert, and drainage sluice	2,500
Pumping machinery, house, &c.	12,000
Keel block timbers and bilge block ways	1,500
Shore rests	300
Drainage	5,000
	62,060
Contingencies 10 per cent	6,206
Total	68,266

L L 5.

IMPROVEMENT OF HARBOR AT CHEBOYGAN, MICHIGAN.

The project for the improvement of this harbor was adopted in 1871, the object being to afford a channel from the original mouth of the river, 200 feet wide and not less than 14 feet in depth.

This project was modified in August, 1882, to provide for the deepening of the basin opposite the steamboat landing, and the entire channel to the 15-foot curve in the Straits of Mackinac, thus making the depth 15 feet for the full width of 200 feet.

At the date of the Annual Report for the fiscal year ending June 30, 1883, the basin had been deepened to 15 feet, and this depth with a width of 200 feet carried, down-stream to the slip between McArthur, Smith & Co.'s and the railroad dock, thence by a channel of the same depth and 110 feet wide for a length of 1,600 feet, and finally a cut 90 feet wide on the axis or range line out to the 15-foot curve in the Straits of Mackinac.

No appropriation was made for the fiscal year 1883–'84, and no work was done.

By act of Congress approved July 5, 1884, the sum of $5,000 was appropriated for continuing the work. Meanwhile no complaints of the insufficiency of the channel have been received, and it has been deemed prudent to reserve this appropriation until a sufficient sum is added to it to make it worth while for contractors to undertake further work, and thus through competition give to the Government the advantage of lower prices, or some pressing necessity arises in the absence of such additional appropriation as will justify the payment of the higher rates for dredging, which the small amount of the funds at present available would compel contractors to charge. Consequently the appropriation of July 5, 1884, still remains.

I think that the estimate heretofore submitted of $50,000 for the completion of the project is entirely too small, and after consideration name $100,000 as the probable cost.

The original estimate for this work was	$395,000
Amount thus far appropriated	118,000
Received from sale of fuel	3
Revised estimate of amount required to complete the project	100,000
Total	218,003
Difference	176,997

The foregoing estimate indicating that the work may be finished for so much less than the original estimate is based upon the possibility that the long pier provided for and intended to protect the channel may be omitted. Should this not prove to be the case the original estimate will be found not to have been too great.

The reasons for undertaking this improvement have been frequently stated in Annual Reports, and it is deemed unnecessary to repeat them, but merely to say that the extension of railroads to and beyond Cheboygan has increased the importance of the point even more rapidly than was anticipated, and the amount necessary to push the project to completion is submitted, and an appropriation of $50,000 for the fiscal year 1886–'87 is recommended.

The work is located in the Michigan collection district, Michigan. The nearest port of entry is Grand Haven, Mich., and the nearest light-house is the beacon on the pier-head marking the outer end of the channel.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount available	5,000 00
Amount (estimated) required for completion of existing project	100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

L L 6.

IMPROVEMENT OF HARBOR AT THUNDER BAY, MICHIGAN.

The project for the improvement of this harbor was adopted in 1876, the object being to obtain an entrance channel, from the bay into the river, of navigable width, and of not less than 13 feet in depth. The project was subsequently modified with a view to obtaining a depth of 14 feet. This had been practically accomplished at the date of the last Annual Report, when it was stated that the improvement is of such a character that it will require attention from time to time, and as the nature and extent of this could not be foretold, it was recommended that a sufficient appropriation be made to render available the sum of $10,000.

This recommendation I now respectfully renew. The sum required is $5,465.96.

At the beginning of the fiscal year the sum of $4,541.96 was available.

No demand has arisen for extensive work, and only $7 have been expended, leaving $4,534.96 still available to meet any sudden emergency.

The commerce directly benefited by this work is that to and from Thunder Bay River, at the mouth of which is situated the important and rapidly growing town of Alpena.

The improvement made gives great satisfaction.

It is located in the collection district of Huron, Mich. The nearest port of entry is Port Huron, Mich., and the nearest light-house is at the work.

Money statement.

July 1, 1884, amount available	$4,541 96
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7 00
July 1, 1885, amount available	4,534 96
Amount (estimated) required for maintenance of existing project	10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00
Submitted in compliance with requirements of section 2 of river and bor acts of 1866 and 1867.	

L L 7.

IMPROVEMENT OF HARBOR AT AU SABLE, MICHIGAN.

The present project for the improvement of the harbor was adopted in 1866, and modified in 1879, the object being to obtain a channel of not less than 10 feet in depth for a width of 100 feet from the Lake to the State Road Bridge at Au Sable.

I have always had serious doubts as to whether an improvement of any substantial value is practicable at this harbor at reasonable cost.

During the past year I have examined the history of the work, and submit herewith in an appendix marked "A" my notes upon the subject.

My study of the matter has forced upon me the conclusion that it is not possible to make any permanent improvement of the harbor at any cost at all commensurate with the advantages to be gained.

A balance of $4,900.55 remaining from appropriations heretofore made has been available during the entire fiscal year, and I have stood ready to propose its expenditure in any alleviative measures, should complaint reach me concerning the condition of the harbor, but none has been made.

The present condition of the work is as follows: Beginning at the State Road Bridge and going downward for a distance of about 3,200 feet, the main channel is separated by the north revetment from a network of smaller channels fed by the river and used to store logs and float them, as required, to the mills below.

The entrance to these log channels just below the bridge supplies them with a quantity of water greater than that which the chutes below can discharge without considerably increased velocity of flow.

The revetment is therefore exposed to a pressure from the rear tending to force it into the channel at the same time that its hold on the bottom is weakened by increased scour.

It is constructed of piles backed by slabs and edgings from the mills. The upper part, for about 1,800 feet, is what is known as the Backus Revetment, constructed originally by private parties and subsequently turned over to the Government.

It consists of a row of piles, backed by edgings, and is supported throughout the greater part of its length by a narrow bank of sand, which separates it from the log channels.

Prior to May, 1883, a portion of it just below the bridge was forced away by the pressure and scour of the water in the log channels, and the remainder was subsequently strengthened by an additional row of piles along its front.

This row shows a gap where two or three piles have been washed out, but has served its purpose up to the present time.

The complete repair of this revetment, including the construction of a suitable entrance chute, was estimated in the Annual Report for 1882 to cost $4,500.

Below the Backus Revetment and connecting with it, is a pile and edging wall built under Major Harwood's direction in 1880–'81. This consists of two rows of piles 7½ feet apart, the inner row capped and waled, and the space between the rows filled with slabs and edgings.

There is no sand-bank in rear. It extends about 1,550 feet downstream, and is pierced by four chutes affording connection between the log booms and the main channel.

It is in good condition along the greater part of its extent with the following exceptions: The filling has sunk below the level of the cap timbers, although not below the water level, and the scouring action of the water escaping through the two lower chutes has caused the revetment to lean outwards at these places.

Continuing down the north bank the space of about 600 feet between the pile and edging revetment and the north pier is occupied by the saw-mill and docks of J. E. Potts & Co. Below these is the pier of crib-work, about 400 feet long. The superstructure is generally in good condition; one crib near the shore end of the pier has sunk about 1½ feet out of level, but is still well above the water's edge.

The last crib, upon which the light-house stands, was badly charred by a fire which occurred May 16, 1885, but is injured more in appearance than in strength.

Passing to the south side of the river at this point, the south pier and its extensions are next in order.

The pier itself was originally built of crib-work, subsequently renewed and repaired, and in 1881 extended by a row of piles 3 feet apart, capped and waled, and stretching in prolongation of the inner face of the pier to the 14-foot curve in the lake, a distance of about 875 feet from the pier.

Mr. J. C. Gram, who owns an extensive lumber-mill here, carried a lumber dock out to within 300 feet of the end of this row of piles, filling in the rear of the piles with slabs and endings. To the end of his dock the structure was practically a pile and edging revetment, and beyond his dock a simple row of piles.

About 150 feet of this unsupported portion was wrecked in 1882. On the 16th May, 1885, a fire, starting in the lumber stored on the dock of J. C. Gram & Co., burned the superstructure of the last crib of the south pier and its extension to the end of the dock, that is, to within 150 feet of the end of the unwrecked portion.

For this distance all the timbers above water are destroyed or so burned as to be worthless. The piles below water are apparently sound, and the backing of edgings in rear of them is still in place. The structure, owing to the absence of capping or string pieces, would offer but little resistance to a displacing force.

The pier itself was uninjured, with the exception of the crib at the lake end; the stone of this is still in place, but the superstruction is destroyed.

The fire did no damage on the north side of the stream beyond scorching the light-house and charring the crib on which it stands.

A stretch of about 450 feet of this south pier was restored and repaired in 1881. This portion is now in good condition.

The remainder of the revetment of the south bank consists of a plank beam wall, built in 1881.

This is simply two rows of piles 2 feet apart from center to center, and capped, the space between them being filled with planks placed on their side, one above another, so as to form a wall extending from the bottom of the stream to the top of the cap. This portion of the revetment, about 1,300 feet long, is in good condition. The plank wall has sunk an average distance of 1½ feet below the cap, but is still above water.

Above the plank-beam wall to the State Road Bridge the bank on the south side has not been revetted by the Government. The length of this stretch is about 1,750 feet.

A few soundings taken at ten different places along the channel show a somewhat greater depth than was found at the detailed examination made in 1883. There is ample depth in the channel itself, but any benefit which might arise from this is neutralized by the bar at the mouth of the river.

The position of this remains practically the same as in 1883, with possibly a slight approach to the pier, but the depth of water over it has diminished.

It is stated that a vessel drawing 8 feet has recently passed over the bar, but this is doubted. The water is higher than usual, but hardly sufficiently so to permit that draught.

The principal industry of the place is the manufacture and shipment of lumber. Nearly, if not quite, all the shipments are now made from piers or docks built out into the lake. Some inconvenience arises from this arrangement, as vessels are sometimes driven away by heavy weather.

If the river were available as a harbor, they would find ready shelter, and if this could be accomplished at a reasonable cost the expenditure would be justifiable.

But holding the opinion expressed above, I am compelled to refrain from recommending any appropriation for the fiscal year 1886-'87.

I am not quite prepared to recommend the abandonment of the improvement, lest further experience should show me to be in error, but suggest that the amount now available be retained in hand to meet any emergency that may arise.

This work is situated in the collection district of Huron, Mich. The nearest port of entry is Port Huron, Mich., and the nearest light-house stands on the north pier. About 130,000,000 feet B. M. of lumber, 45,000,000 lath, and a quantity of salt are annually shipped from this point.

Money statement.

July 1, 1884, amount available	$4,900 55
July 1, 1885, amount available	4,900 55
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	4,900 55

A.

NOTES ON THE HISTORY OF THE IMPROVEMENT AT THE HARBOR OF AU SABLE, MICHIGAN.

In his report of October 16, 1866 (Appendix Q, Annual Report of the Chief of Engineers, 1866), General William F. Raynolds submitted the first project, with estimates, for the improvement of the mouth of Au Sable River. At that time the mouth of the river was about 150 feet wide, with 5 feet of water on the bar. Above the mouth from 7 to 10 feet could be carried for a distance of about a quarter of a mile, in a channel from 50 to 175 feet in width. Above that point not over 5 or 6 feet could be carried.

The project provided for two parallel piers of crib-work, 100 feet apart, extending out from the shore line to the 12-foot curve, the material to be afterwards removed to that depth by dredging, and the dredged cut extended up-stream to the 6-foot curve. The piers to be in length 700 feet on the north side and 1,100 feet on the south side. The estimate of cost amounted to $114,754.40, and only provided for filling the cribs with stone to the height of the water line.

By act approved March 2, 1867, the sum of $50,000 was appropriated for the work, and on the 28th the charge of it was assigned to General T. J. Cram, who concurred in the general features of the project which had been submitted by General Raynolds, but recommended that it be modified to such an extent as to provide for 10 feet of water instead of 12 feet, with a cheaper mode of construction and shorter piers, which reduced the estimate to $69,367 for the 10-foot harbor and $82,892.72 for one of 12 feet.

At the same time General Cram emphatically expressed the opinion that the "harbor," * * * "however well we may construct it, will need in a few years much dredging from the enormous quantities of sand which the river brings along from the interior into the lake to be deposited at the mouth." (Annual Report Chief of Engineers, 1866, page 147.) And again:

> * * * I am satisfied that to maintain even that depth (10 feet) we shall have to resort to dredging, or extend the piers indefinitely beyond the present proposed limits. A bar will form across the mouth in a few years after constructing the piers. (Annual Report Chief of Engineers, 1866, page 149.)

Proposals for the work were opened May 31, 1867, but owing to contention amongst the bidders arising from different constructions of the laws relating to awarding contracts, it was not until the 16th December following that the articles of agreement were finally completed and approved. It was then too late in the season to do more than begin preparation of the requisite materials, and all work was necessarily deferred until the opening of the following season. Meanwhile a resurvey was made of the locality, and a proper bench-mark established.

Upon the opening of the season of 1868 active operations were begun, and in his Annual Report for the fiscal year ending June 30, 1868, General Cram remarks:

> This will always be an expensive harbor to keep open, owing to the enormous quantity of sand coming down the river and floating lake-shorewise. The annual expenditures to keep it in order will not be less than $6,000.

These opinions in regard to the difficulty of maintaining the requisite depth of water at this harbor, expressed before the work had made any progress, have been so amply fulfilled that special attention is invited to them.

By the close of the fiscal year 1868–'69 the north pier had been extended 240 feet and the south pier 660 feet, a length sufficient to indicate whether the predictions in regard to the refilling of the channel were well founded. The effect of the spring freshets of 1869 was to scour out the shoal between the piers from a depth of 2½ or 3 feet to full 7 feet, and to move the 10-foot curve 310 feet farther out, showing that the result of the scour was simply to move the deposit farther out. The short time was not sufficient to fully build up the bar, but the process was rapidly going on. In his Annual Report for that year General Cram refers to the matter in the following terms, viz:

> This river is long, rapid, and, as its name imports, is full of sand, which, being washed down from all the way for 120 miles up, forms an everlasting deposit at its mouth.

Having had another year's experience at the locality, he now reports that "the annual expense of keeping this harbor open, after completing it, will be $3,000." There was no special appropriation made in 1869 for the work, but the sum of $2,970 was allotted to it under the act approved April 10, 1869.

The progress made during the fiscal year 1869–'70 extended the work so that on the 30th June the north pier had a length of 392 feet and the south pier 842 feet.

The annual report for 1869–'70 was prepared by General O. M. Poe, who, after a careful consideration of all the data upon the subject, remarked in regard to the maintenance of the harbor:

> * * * I deem it prudent to anticipate a necessity for dredging more or less every year, and do not think the estimate of the probable annual cost of maintenance heretofore submitted by General Cram, namely $3,000, at all too large.

By act approved July 11, 1870, $15,000 were appropriated for the work, and by that of March 3, 1871, the further sum of $10,000.

The annual report of General Poe for the year 1870–'71 contains the following paragraph, viz:

> Comparing the depth of water in the channel with that of previous years, the harbor shows a marked improvement. Closing the gap G. H. has increased the current so much that it has entirely removed the bar in front of the harbor mouth, and made a channel of 10½ to 11 feet in depth. The river inside shows an average depth of 11¼ feet.

This condition of the improvement was hopeful in the highest degree, and seemed to indicate a littoral current of sufficient power to carry away the sand and other matter brought beyond the ends of the piers by the river current. But this favorable condition was not continued, since the annual report for the year 1871–'72 contains the following, viz:

> By referring to the chart of the harbor transmitted herewith, it will be seen that the 10-foot curve is now distant from the outer end of the piers 420 feet, an increase of 280 feet during the year. This is largely in excess of the increase in former years, and makes a much less hopeful exhibit for the future of the improvement.

This was at the time attributed to the fact that cuts had been made across points in the river above. These cut-offs, of course, had an increased current through them, which in some instances was used to scour out the greater portion of the material removed. This was done by opening a small cut, and leaving the current to do the rest. In a similar manner mill-ponds and boom-cuts were scoured out, and altogether a very large amount of material was dislodged and carried by the current to the outer end of the piers. But instead of being then all carried along shore by a littoral current, much of it was deposited beyond the ends of the piers with the effect stated.

Under this state of affairs it was proposed with the appropriation of $10,000 made by act approved June 10, 1872, to extend the north pier (except the superstructure) a distance of 150 to 200 feet, with the hope of throwing the current more to the eastward, and, by its scouring action, improve the condition of the bar along the line where the best water was then found. At the same time the engineer felt constrained to say that the sanguine expectations concerning the value of this improvement originating in the excellent showing of the previous year had not been realized, and that he felt at a loss what to recommend for the future. He further remarked that the proposed extension of the north pier, if carried out, would be at best an experiment, and might result only in further illustrating the never-ending operation of the pier-extension system, and expressed the opinion that—

> If the action should not prove to be more favorable than during the last twelve months, it would be cheaper to dredge a channel across the bar annually after the winter and spring freshets have done their work than to further extend the piers.
>
> I instructed the local agent to extend his surveys of this season sufficiently far outward to determine whether or not a bar of sand reported to exist off the mouth of the harbor was actually there. It was found at a distance of about a mile from the outer

end of the piers, with a maximum depth of 18 feet of water, and on the greater portion of it only 13 feet.

The general depth of water inside this bar is from 3½ to 4½ fathoms. This bar is not well defined on the lake survey published charts, and is, I fear, in process of formation.

The indications thus developed were of the gravest character. If such a bar was in process of formation at so short a distance from the ends of the piers, it could only be a question of a short time when the pier extension would have to be carried out to and beyond it or the attempt to improve the harbor by that method abandoned.

The proposed extension of the north pier was not made, and the annual report for 1872–'73, by General G. Weitzel, informs us that "the 10-foot curve is now distant from the outer end of the piers 680 feet, or an increase from last year of 260 feet. This shows a decrease of 20 feet from that of the year previous, but with a greater amount of bar, there being but 5 and 6 feet of water this year where there was 7 and 8 feet last year."

The localities whence the material came to form this deposit are described in the report. But the great point was not the places from which the material was brought, but where deposited, since the river is essentially a sand-bearing one, and the drift must either be carried clear of the harbor, or, in a greater or less time, form an obstruction.

It was determined to give immediate relief by dredging the bar at the mouth of the river. This would also serve as an experiment to determine the length of time it would keep open, and thus compare the relative cost of dredging and pier extension.

At the same time General Weitzel stated his intention to ask for authority to make a survey to determine the feasibility and cost of an artificial connection with Tawas Bay.

He did not recommend any appropriation for the work for the next fiscal year.

The operations during the year 1873–'74 consisted in keeping the works already executed in repair, and in dredging a cut to 10 feet in depth across the bar which had formed during the spring of 1873. The Annual Report for the year gives, in detail, a description of the encroachments on and abuse of the channel referred to in the report for the preceding year, which tended in a great degree to neutralize the work that the Government was doing.

By act of June 23, 1874, it was directed that a resurvey of Au Sable River be made and dock-lines established. This was completed by the latter end of September, 1874, and it was found that the channel dredged in the fall of 1873, to a depth of 10 feet and width of 100 feet, had filled to such an extent that there was but 6½ to 7 feet on the bar. As this cut had been dredged more particularly for purposes of experiment, it is to be regretted that it hardly had a fair test, because the encroachments and abuse before referred to had aided in filling the cut more rapidly than would have been the case under the operation of natural causes alone. The local engineer recommended the extension of the north pier a distance of 300 feet, and that the channel across the bar be again dredged out, at the same time remarking that this would be of little use unless the encroachments and abuse by individuals and corporations were stopped. General Weitzel, the engineer in charge, declined to recommend any appropriation for further attempt at improvement until the local or State authorities should take the requisite steps to stop these lawless acts, and only asked for $2,500 to keep existing works in repair.

During the year 1875–'76 no work was done, and no steps were taken by either local or State authorities to put a stop to the lawless acts previously referred to. Meanwhile, the main interests centering at Au Sable abandoned the river, and moved to piers and docks built out into the lake and asked for a breakwater in the lake in front of them to protect these docks (or piers) and to serve as a harbor of refuge.

General Weitzel again declined to do more than recommend an appropriation of $2,500 to keep the existing works in repair.

By act of August 14, 1876, the sum of $1,000 was appropriated for this harbor, but during the year 1876–'77 nothing was done beyond an inspection of and report upon it by Capt. A. N. Lee, Corps of Engineers, General Weitzel's assistant, who appears to have visited the harbor in October, 1876, and again in June or July, 1877. At the latter visit he found the work in a much worse condition than at the former. Soundings between the piers showed 10 to 13 feet of water from the angle in the south pier to the heads of the piers. Outside the piers he found nothing less than 8½ feet of water, showing the bar to be in about the same condition as in July, 1875. From the angle in the south pier to the upper end of the same, the depth shoaled from 10¾ feet to 6¼ feet. Above that the river was practically useless for vessels, as there were only 3 feet of water in some places. Captain Lee further remarked that—

> This state of affairs has been caused by the gradual encroachment on and changing of the channel by the lumbermen in driving piles, building docks, cutting passages through the river banks for their own convenience in reaching their mills with their logs, in fact, using the river in every way as if it were their own private property, and not a common highway.

General Weitzel thereupon reported that unless he received instructions to do so he would not expend another cent on this work.

On the 27th April, 1878, the charge of this work was transferred to Maj. F. Harwood, Corps of Engineers. In his annual report for 1877–'78 he states that he had visited the work and found it in substantially the same condition as reported to Major Weitzel by Captain Lee, but he did not agree with him as to the extent of the damage done to the river by the encroachments, &c., often spoken of. However, he concurred in the general conclusions of his predecessor, and in his policy of refraining from further attempts at improvement until the conditions were changed.

He expressed the opinion that if the channel were confined to a uniform width of 100 feet it would soon scour to a uniform depth of 10 feet clear to the mouth of the harbor, and, with a slight aid in dredging the bar and removing the river obstacles in Au Sable, it could be made navigable to Oscoda.

In conclusion, however, he recommended that the harbor be abandoned until such a time as the United States should be in position to assume jurisdiction over the river fronts to that point.

The repetition of these conclusions appears to have had its effect, for, by an instrument in writing this jurisdiction was ceded to the United States by the owners of the river fronts. This being satisfactory, steps were taken to make further attempts to improve the harbor.

Under date of February 8, 1879, Major Harwood submitted a project for restoring and improving the harbor, and estimated that it would cost $35,000 to carry it into effect. The project was approved, and by act of March 3, 1879, the sum of $7,000 was appropriated towards it. Subsequently, for reasons given in the Annual Report for that year (1878–'79), Major Harwood reduced his estimate to $25,000. It is doubtful whether this reduction in his estimate was warranted.

During the year 1879–'80 operations were carried on in pursuance of the approved project, and resulted in the completion of a plank beam revetment on the southwest bank of the river, and the construction of a pile and edging revetment on the northeast bank as far down-stream as the Au Sable Bridge.

By act of June 14, 1880, a further sum of $7,000 was appropriated for the work.

In closing his annual report for the year Major Harwood remarks that when the river banks are revetted, from Oscoda Bridge to the Lake, the interior improvement will have been completed, but that "other measures of improvement will probably be needed in the event of the formation of a bar, as is most probable, from the sand deposit carried down by the current."

During the year 1880–'81 the revetting of both banks of the river was completed from Oscoda Bridge to a connection with the former United States piers, and the angle in the old south pier was improved, by making it less abrupt.

The river being now confined within a channel of from 80 to 100 feet in width, the high water of the spring of 1881 scoured it down to the bed gravel, giving in general a depth of 10 feet, and not less than 9 feet at any place. As was to have been expected, the sand was deposited at the mouth of the river forming a bar with only 6 feet on it.

By act of March 3, 1881, $6,000 were appropriated for the work, which, together with balances from previous appropriations, was expended in 1881 in extending a pile and edging revetment, from the outer end of the old south pier, a distance of about 850 feet, to the 14-foot curve, and in May, 1882, in dredging the channel to a depth of 10 feet.

The result of these operations was to obtain an entrance channel available for vessels drawing from 9 to 10 feet of water, and a channel of 8 feet as far as Oscoda Bridge.

By act of August 5, 1882, $5,000 were appropriated for the work.

One hundred and fifty feet of the pile and edging revetment constructed in 1881, in extension of the south pier, was wrecked in the fall of 1882. It had been expected that this extension would guide the drift current of the river in such a manner that the 10-foot channel dredged in May, 1882, would receive the benefit of a scour and thus hold that depth. Such was not the result, however.

An examination made in May, 1883, established the fact that no scouring effect can be produced by the extension of the south pier alone; that the bar is continually and gradually increasing in size, directing the river current to the northward, and that this will continue until the north pier has been extended to an equal or greater distance.

At the time of the examination there was but little more than a depth of 4 feet available on the bar, although fully 8 feet could be carried thence to Oscoda Bridge.

O. M. P.

L L 8.

IMPROVEMENT OF SAGINAW RIVER, MICHIGAN.

The project for this improvement was adopted in 1874, and modified in 1878, the object then being to attain a depth of not less than 10 feet over the bars in the river. The natural channel was torturous and obstructed by numerous bars, having not more than 7 feet of water at the shoalest part. As time passed and the lake harbors generally were improved, the commerce at Saginaw River became clamorous for a greater depth of channel, and in 1882 a new project was adopted, the aim of which was to secure a channel of 200 feet in width with a depth of 14 feet from Saginaw Bay to Bay City, and 12 feet thence to the head of the river, a total distance of about 23 miles.

The details of the project are given at pages 1863 *et seq.* of the Annual Report of the Chief of Engineers for the year ending June 30, 1883, to which I beg to refer.

At the beginning of the present fiscal year there were no contracts in force. By the river and harbor act of July 5, 1884, the sum of $50,000 was appropriated for continuing the work, of which one-half was to be used "opposite Bay City for deepening the channel from the river into the bay," and remainder on the "river above Bay City." A project was submitted for the application of this appropriation, and contracts were entered into as follows:

(1) On August 29, 1884, with Carkin, Stickney & Cram, for dredging above Bay City, at 27½ cents per cubic yard, scow measurement, to be completed on or before August 1, 1885.

(2) On October 2, 1884, with Louis P. and James A. Smith, for dredging opposite Bay City, for 23 cents per cubic yard, scow measurement, to be completed on or before September 1, 1885.

(3) On October 2, 1884, with Carkin, Stickney & Cram, for dredging on bar at the mouth of Saginaw River, for 38 cents per cubic yard, scow measurement, to be completed on or before September 1, 1885.

Under the first contract operations were begun at East Saginaw September 10 and completed November 22, 1884, when 35,145 cubic yards of material had been removed.

They were begun at Carrollton October 17 and closed for the season November 28, 1884. They were resumed April 25 and completed June 17, 1885, when 43,542 cubic yards had been removed.

Under the second contract operations were begun opposite Bay City October 15 and closed for the season November 26, 1884. They were resumed April 28 and completed June 18, 1885, when 40,036 cubic yards of material had been removed.

Under the third contract operations were begun on the bar at the mouth of the river October 15 and closed for the season November 25, 1884. They were resumed April 29, 1885, and were in progress at the close of the fiscal year, 13,832 cubic yards of material having been removed.

The details of the foregoing are given in the appended report of Mr. B. H. Muehle, assistant engineer in local charge, to which I beg to refer, as well as for information touching the area as dredged and the results attained.

It will be observed that these results are not altogether encouraging. The channel dredged at East Saginaw appears to have been filled up by the spring freshets, and that opposite Bay City to have been refilled almost as rapidly as it was dredged. The results at other localities seem to have been better. An examination during the coming winter may show that the obstructions at East Saginaw and Bay City have not been reformed as rapidly as we now fear.

In further prosecution of the work it may be found necessary to extend the revetments at Carrollton and Crow Island, the effect of which would be to give the channel at those points a greater degree of permanence. At East Saginaw and Bay City, owing to the local conditions, it seems to be practicable only to remove the bars by dredging wherever they form to such extent as to constitute material obstruction. It must not be forgotten that the original project provides for annual dredging, though the estimate of the amount necessary is probably too small.

Notwithstanding the temporary character of the benefits derived from this annual dredging, I recommend that it be continued, as giving relief to a commerce of nearly 2,000,000 tons, having a value of $20,000,000. The cost of this relief will be much less when those portions of the channel which admit of permanent improvement, shall have been completed.

I concur in the greater portion of the recommendations contained in Mr. Muehle's report, but differ in regard to the purchase and maintenance of a snag-boat, and am of opinion that a greater amount should be expended on the bar at the mouth of the river. Accordingly, I submit the following modification of his estimate for the next fiscal year, viz:

Repairs to revetment at Carrollton	$9,000
Extension of revetments at Carrollton	10,000
Dredging at Carrollton	18,000
Revetment at Crow Island	3,000
Dredging at Crow Island	10,800
Continuing dredging opposite and below Bay City	100,000
Dredging at other places for immediate relief	15,000
Total	165,800

Of the foregoing, portions would be applicable as follows:

Above Bay City	$50,800
Opposite and below Bay City	100,000
For general use on the whole river	10,000
Total	165,800

The Saginaw River improvement is located in the collection district of Huron, Mich. The nearest light-house is at the mouth of the river. The nearest port of entry is Port Huron, Mich.

Money statement.

July 1, 1884, amount available		$1,606 63
Received from sale of fuel		16 13
Redeposit (error in voucher 13, second quarter, 1884)		6 00
Amount appropriated by act approved July 5, 1884		50,000 00
		51,628 76
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$40,483 43	
July 1, 1885, outstanding liabilities	2,636 21	
		43,119 64
July 1, 1885, amount available		8,509 12
Amount (estimated) required for completion of existing project		371,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		165,800 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for dredging Saginaw River, Michigan, above Bay City, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 25, 1884, *in accordance with advertisement dated August* 6, 1884.

No.	Names and residences of bidders.	Price per cubic yard, scow measure
		Cents.
*1	Carkin, Stickney & Cram, East Saginaw, Mich	21½
2	Chicago Dredging and Dock Company, Chicago, Ill	22
3	Fitzsimons & Connell, Chicago, Ill	25
4	James Rooney, Toledo, Ohio	27
5	Louis P. and James A. Smith, Cleveland, Ohio	28
6	Castle Sutherland, East Saginaw, Mich	[illegible]

* Recommended for acceptance.

Abstract of bids for dredging Saginaw River, Michigan, opposite Bay City, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on September 29, 1884, *in accordance with advertisement dated September* 10, 1884.

No.	Names and residences of bidders.	Price per cubic yard, scow measure.
		Cents.
*1	Louis P. and James A. Smith, Cleveland, Ohio	23
2	Carkin, Stickny & Cram, East Saginaw, Mich	23½
3	Thomas M. Hubbell, East Saginaw, Mich	25
4	James Rooney, Toledo, Ohio	25
5	George Talbot, Buffalo, N. Y	26
6	Castle Sutherland, East Saginaw, Mich	30
7	Dodge & Petrie, Little Falls, N. Y	30

* Recommended for acceptance.

Abstract of bids for dredging bar at mouth of Saginaw River, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on September 29, 1884, *in accordance with advertisement dated September* 10, 1884.

No.	Names and residences of bidders.	Price per cubic yard, scow measure.
1*	Carkin, Stickney & Cram, East Saginaw, Mich	$0 38
2	George Talbot, Buffalo, N. Y	46
3	Castle Sutherland, East Saginaw, Mich	49
4	James Rooney, Toledo, Ohio	49
5	Louis P. and James A. Smith, Cleveland, Ohio	51
6†	C. F. Dunbar, Buffalo, N. Y	55
7	Dodge & Petrie, Little Falls, N. Y	[illegible]
8	Thomas M. Hubbell, East Saginaw, Mich	[illegible]

* Recommended for acceptance. † Informal; bid by telegram.

REPORT OF MR. B. H. MUEHLE, ASSISTANT ENGINEER.

EAST SAGINAW, MICH., *July* 1, 1885.

GENERAL: I have the honor to submit the following report of operations on the improvement of Saginaw River, Michigan, for and during the fiscal year ending June 30, 1885.

On the 5th of July, 1884, an appropriation of $50,000 was made by Congress for continuing the improvement of Saginaw River, of which sum $25,000 were to be used opposite Bay City for deepening the channel from the river into the bay, and remainder on the river above Bay City.

By advertisement dated August 6, 1884, bids for dredging Saginaw River above Bay City were invited. They were received and opened August 25, and contract awarded to the lowest bidders, Messrs. Carkin, Stickney & Cram, of East Saginaw, at 27½ cents per cubic yard, scow measurement. This contract was dated August 29, 1884.

In response to advertisements dated September 10, 1884, bids for dredging Saginaw River opposite Bay City were received, opened September 29, 1884, and contract given to Messrs. Louis P. and James A. Smith, of Cleveland, Ohio, at 23 cents per cubic yard, scow measurement, contract being dated October 2, 1884. On the 29th September bids were also received for dredging bar at mouth of Saginaw River, and contract awarded to the lowest bidders, Messrs. Carkin, Stickney & Cram, at 38 cents per cubic yard, scow measurement, date of contract being October 2, 1885.

On the 26th of August, 1884, I was assigned to the local charge of the improvements of Saginaw River and received your verbal instructions in regard to the general conduct of the work.

DREDGING.

The operations during the fiscal year ending June 30, 1885, under the several contracts above mentioned, consisted of dredging only, and are given below in tabular form, specifying the different localities where dredging was done, the dates between which the work was carried on, the number of cubic yards excavated, and the cost of removal, as follows:

Localities.	Date.	Cubic yards.	Cost.	Total.
1. Above Bay City:				
At East Saginaw	Sept. 10 to Nov. 22, 1884	35,145		$9,664 87
At Carrollton	Oct. 17 to Nov. 28, 1884	4,674	$1,285 35	
Do	April 25 to June 17, 1885	38,868	10,688 70	
				11,974 05
Total		78,687		21,638 92
2. Opposite Bay City	Oct. 15 to Nov. 26, 1884	15,416	3,545 68	
	April 28 to June 18, 1885	24,620	5,662 60	
Total		40,036		9,208 28
3. Bar at mouth	Oct. 15 to Nov. 25, 1884	5,019	1,907 22	
	April 29 to June 30, 1885	8,813	3,348 94	
Total		13,832		5,256 16

Total opposite and below Bay City	$14,464 44
Total above Bay City	21,638 92
Grand total	36,103 36

The contracts for dredging above and opposite Bay City were closed on the 17th and 18th of June, 1885, respectively, by reason of exhaustion of the portion of the appropriation allotted to these localities. At the mouth of the river dredging was continued until the end of the fiscal year.

AREAS DREDGED.

In front of East Saginaw the channel was dredged between the Genesee Avenue Bridge and the Flint and Pere Marquette Railroad Bridge, with two cuts, 20 feet wide and about 2,900 feet long each, completed, and one cut, 1,920 feet long, unfinished. Below the railroad bridge there were four dredge-cuts made, giving a channel 12 feet deep and 80 feet wide across the bar, an average length of 1,250 feet.

At Carrollton, a shoal above the up-stream end of the plank-beam wall was entirely removed by making seven dredge-cuts through it and removing 7,384 cubic yards of sand. Across the lower end of the Carrollton Bar a channel was dredged 1 feet deep and 100 feet wide between the bottom of the slopes. One-half of the area dredged included a part of the channel made in the fall of 1883, and which had filled again with sand from the adjacent bar. Two tracings, marked I and II, are herewith respectfully submitted, illustrating the dredging operations at East Saginaw and Carrollton.

Opposite Bay City four complete dredge-cuts were made, giving a channel 14 feet in depth and about 90 feet wide between the Portsmouth Bridge and the foot of

Sixth street, Bay City. The channel dredged during the previous year had filled up so that the westerly boundary line was difficult to find, but the present channel has been made in continuation of the project, on lines as originally laid out. A part of a fifth cut was made along the westerly line of the new channel; it is 2,510 feet long and extends across the shoalest area, called the "Bradley Bar," giving 165 feet width in that reach of the dredged channel.

The dredge at the mouth of the Saginaw River began a new cut at the shore end of the bar, being the second cut east of the range line, and up to June 30, 1885, had moved a distance of about 5,592 linear feet. A second dredge was placed in commission on the 22d of June, 1885. It started another cut east of the range line, and had moved 410 linear feet at the end of the fiscal year.

PRESENT CONDITION OF IMPROVEMENTS.

Careful examinations have just been made of the channels at East Saginaw, Carrollton, and Zilwaukie; the latter for the purpose of obtaining data for laying out work for the next season in continuation of the general project of improvement. The soundings are plotted, and tracings of these surveys accompany this report, marked III, IV, and V, respectively. The channels in front of Bay City and at the mouth of the river, where dredging has been done, as well as all other shoal areas comprised in the general project, have not been examined at this time. Owing to the shifting nature of the sand bottom at most of these places, it is advisable to defer further examination until such time as, with a liberal appropriation at command, they may be selected for improvement in the order of their importance for the benefit of navigation. However, I am enabled to state that complaints are especially made of the shoals above the Mackinaw Street Bridge and near the Bristol Street Bridge at Saginaw City. The water having been averaging 2 feet high above United States datum level since the opening of navigation, and no complaints having reached me touching the dredged channels at New York Works and Willow Island, it is presumed that these are in good navigable condition. The map of soundings taken at East Saginaw, Sheet III, shows that the channel dredged in the fall of 1884 has filled up again. This has doubtless occurred during the spring freshet, but whether by accretions of sand brought down the river, by the caving in of the banks or slopes, or by a general leveling process, it is difficult to determine without more frequent and careful examinations. My own opinion inclines to the latter cause for the following reason: In September, 1879, there were removed from the channel in front of East Saginaw 4,12 cubic yards of sand, completing two dredge-cuts between the bridges. This was done to afford temporary relief to navigation, and a uniform depth of 10 feet was made. In less than a month afterward the river bottom was found to be as level as before dredging. Heavily loaded vessels, drawing even more water than the depth of the channel permits, are almost constantly passing the East Saginaw River front and plow through the fine sand of which the river bed is composed. Tugs and river steamboats also stir up the water in a manner to lift up and move the sand, so that it is impossible to make a permanent improvement of the channel by dredging only, and all efforts in that direction will be neutralized by the disturbing elements above described.

The shoal above the Carrollton Channel was removed partly in the fall of 1884, and the greater portion during the month of May, 1885. On examination of the chart, Sheet IV, it will be seen that the part which was completed before the freshet shows unmistakable signs of beginning a new growth. However, as there is a good channel of sufficient width alongside, the danger of obstructing navigation is not imminent.

Below the gap in the revetment, where a uniform depth of 12 feet was made, the new channel has remained in good condition, showing nearly its original width between slopes down to the ends of the revetments. Beyond these the channel, which was completed as late as the 17th of June, 1885, has again filled up to a considerable extent, on the west side principally, by the caving in of the bank of sand which forms the lower end of the Carrollton Bar.

On the map of soundings taken opposite the Crow Island wing-dam (Sheet V) not a trace can be found of the channel dredged 12 feet deep along the boom on the west side of the river during the spring of 1884.

The new channel in front of Bay City, which is over 1 mile in length, is reported by the inspector in local charge of the dredging as having filled up, even while the work was in progress, to such an extent that in some places it was difficult to find the west line of a cut just completed while establishing the east line or range of the next or adjoining cut. On account of the width of the river in this locality and the frequency of interruption from passing vessels and rafts, accurate soundings cannot well be obtained in summer except at considerable expense. A survey on the ice can be made better and cheaper, and I therefore recommend that such examination be made, if funds are available for the purpose.

A like survey should also be made of the channel across the bar at the mouth of the river in order to obtain correct information as to the condition of the improvements made under the last two appropriations. This survey is of even greater importance than one at Bay City, because it is necessary that several unfinished dredge-cuts on the west side of the range line be correctly located and their termini instrumentally connected with the transit-stations on the west shore of Saginaw Bay, thereby facilitating the work of placing dredges in summer.

PROPOSED OPERATIONS.

Dredging the channel above and opposite Bay City having been discontinued, by reason of exhaustion of the appropriations, there will be no work done in continuation of the present project of improvement at these localities during the fiscal year ending June 30, 1886.

It is expected that with the aid of the two dredges now at work on the bar at the mouth of Saginaw River, the contractors will be able to finish the amount of dredging contemplated on or before the 1st of September, 1885, on which day their contract expires. The ice surveys hereinabove recommended may be made if sufficient funds are reserved from the balance of the present appropriation for that purpose.

During the last session of Congress no appropriations were made for the improvement of rivers and harbors during the fiscal year ending June 30, 1886. Consequently the proposed operations on Saginaw River for that year are reduced to a minimum as above set forth, and this report might here be concluded.

In anticipation, however, of the possible passage of a river and harbor bill during the next session of Congress, by which appropriations may become available for the resumption of works of improvement on this river during the season of 1886, I beg leave to submit a few facts and figures, compiled in a brief illustrated history of the Carrollton and Zilwaukie bars, and which I present as a basis for recommendations involving amendments of the present approved project. In this connection, and for this purpose, I have prepared, for ready comparison, reduced copies of the principal maps of surveys of these bars, which were made since the time the Government was first called upon to take in hand the improvement of the river for the benefit of commerce. The maps are shown on the accompanying tracings marked Sheets VI and VII.

THE "CARROLLTON BAR"

is located in Saginaw River, 16 miles from its mouth, and about 2 miles below the city of East Saginaw. After the county and city authorities, during several seasons, had expended over $100,000 in an endeavor to maintain a navigable channel of uniform depth across the bar, but without material success, the attention of the United States Engineer Department was called to this the most serious of all the obstructions to navigation in the upper reaches of the Saginaw River in the year 1873. A survey was made under the direction of Maj. G. Weitzel, Corps of Engineers, United States Army, by Assistant Engineer Henry Gillman, with a view to the permanent improvement of the channel in this locality. This report is dated November 7, 1873, and is found in the Report of the Chief of Engineers for 1874. Figure 1 of the accompanying drawing, Sheet VI, is a reduced copy of the part of the map of this survey embracing the Carrollton Bar. In his report Mr. Gillman refers to the probable origin of the great impediment to navigation and its growth, also to the location of Wicke's and McLane's docks as exerting "an injurious influence in this direction." Yet he proposes as a remedy the construction of a pile work, 3,930 feet long, with its initial point or up-stream end immediately adjoining the same Wicke's Dock, the location of which he deems injurious. The pier was designed to reach above high-water mark and to "conform as much as possible to the general direction of the east shore of the river." It was deemed adviseable, "that some dredging should be done in the channel to perfect the work," and it was then believed "that the first spring freshet, confined to the river-bed in the manner proposed, would sweep away the entire obstruction complained of, and make a permanent channel of sufficient depth throughout." The cost of the pier was estimated at $23,143.25, and of dredging a channel 100 feet wide and 12 feet in depth, 58,000 cubic yards, 25 cents, at $14,500.

This original project was submitted and approved, and under the first Government appropriation of $15,000, June 23, 1874, the work was begun. By December 1, 1874, 700 feet of the revetment were completed.

March 3, 1875, $30,000 were appropriated and the pier was extended 2,255 linear feet during the fiscal year 1875–'76. In his annual report of July 8, 1876, Capt. A. N. Lee, Corps of Engineers, United States Army, says: "The asked-for appropriation of $11,000 will, if granted, build about 950 feet of revetment. This will make the total length of the work 3.905 feet. It will probably require 1,000 feet more to bring the work to deep water." During the same fiscal year 33,643 cubic yards of sand were dredged at 37 cents per cubic yard, costing $12,447.91, and the 6-foot curve is reported to have moved down-stream 150 feet, at the head of the bar, and down from the revetment, from 75 to 150 feet.

In Figure 1 I have also traced a plan for a middle ground, designed and submitted by the inspector on the work in 1875; but as no reference is made to it in the official report of that year, this project was doubtless abandoned in its incipiency.

Figure 2 shows the condition of the improvement at the beginning of the working season of 1877 and previous to the expenditure of the appropriation of $11,000 made August 14, 1876.

The result of an examination in May, 1877, having shown that there was a strong current setting in behind the revetment on account of its peculiar location near the axis of the river, a bulkhead connecting the head of the revetment with the east shore was projected by Maj. F. Harwood, Corps of Engineers, United States Army, which was approved and built in 1877. Five hundred feet were added to the lower end of the revetment complete, and 330 feet more partially finished. This addition making the revetment as long as originally designed, without obtaining in any marked degree the hoped for results, viz, a deepening of the channel in front of it by scour, it was deemed advisable to connect the lower end of the revetment with the shore by an arm 115 feet long, thus confining the area behind the revetment between fixed boundaries in order to make dead water therein, and seeking to obtain an increased scouring action in the channel in front of the revetment. This was also partially completed in 1877, and in August of that year the channel was dredged 90 feet wide and 10 feet deep, removing 3,871.5 cubic yards of sand at 35 cents per cubic yard, costing $1,355.03.

A portion of the appropriation of $25,000, June 18, 1878, was used in the completion of the revetment in the fall of that year, and redredging the channel to 10 feet depth and 100 feet wide, removing 7,286 cubic yards at 14 cents per cubic yard and costing $1,020.04.

In January and February, 1879, elaborate and accurate surveys were made and soundings taking through the ice at all points needing improvement, including the Carrollton Bar, a reduced map of which is shown at Figure 3, sheet VI. Then it was discovered "that owing to the sluggish current of Saginaw River and occasional slack-water, and sometimes even an up-current making across the Carrollton Bar, there was not sufficient scour in the new channel to maintain it in the face of the drift of light sand from the river above and from off the face of the Carrollton Bar. A new work was therefore projected to fence in the Carrollton Bar and confine the channel to a width of 200 feet, so as to obtain the maximum scouring effect of any down-stream current without confining too much the channel limits. This work consists of a plank beam training-wall" (extract from Major Harwood's annual report of 1879), which proposed structure is shown in dotted lines on Figure 3. This beam wall was constructed during the season of 1879 with a portion of the appropriation of $8,000 made March 3, 1879. It is 3,500 feet long; its initial point opposite the oar factory was built in 8 feet depth of water, and its lower end crossing near the crest of the Carrollton Bar, with only 2 or 3 feet over it. The total cost of this structure was $6,420.65, or $1.83 per linear foot.

From September to October 15 1879, a dredge was employed, renewing the Carrollton channel to 100 feet width and 10 feet depth, removing 11,113 cubic yards of sand at a cost of 11 cents per cubic yard, a total of $1,222.43. In the spring of 1880 there was an exceptionally high freshet, lasting several weeks, with a strong current rushing through the channel, between the revetment and beam wall. The effect on the channel-bed was immediate and positive, to give a description of which I beg leave to quote from a report made by me to Major Harwood, under date July 30, 1880, after an examination of the Carrollton channel and beam wall: "The first or upper section of the plank beam wall at Carrollton Bar, being built on a line drawn diagonally across the axis of the river channel, and receiving, as it does, the greater and central portion of the body of water descending at that point * * * has proved inadequate in strength to resist that force, and on account of its peculiar construction permits the scouring action of the current to undermine it, greatly diminishing its utility as a water-tight bulkhead. This section when built, in August, 1879, was in 8 to 9 feet of water. Soundings taken March 18, 1880, show an average depth on both sides of 12 feet; on April 5, 13 feet, and on July 24, 1880, over 15 feet. If this scouring action underneath the plank beam continues the entire structure is liable to fall over for the want of sufficient depth of penetration of the piles which hold it upright. * * * The channel between the United States revetment and beam wall (July 24, 1880) is in very good condition, comparing it with its cross-section of late in the fall of 1879 and the spring of 1880. In the old channel originally made near the revetment there is good 10 feet of water; and even close to the beam wall, a width of 75 feet, 7 to 8 feet of water has been made by the scouring action of the current through this canal. Unfortunately, the great bulk of the sand thus moved was deposited immediately below the revetment" * * * forming an extensive and growing bar in that locality. In fact, the old Carrollton Bar had shifted its position to the lower end of the canal, which seemed to indicate that the revetments were not extended far enough down-stream past the tail of the bar.

The upper section of the beam wall above referred to was re-enforced by taking up the plank beam, driving two rows of piles, and filling the interval with edgings and a top layer of stone. This was done in September and October, 1880, at an expense of $936.16. The other 3,000 linear feet of plank beam had also settled considerably on account of the deepening of the channel by scour, and had to be built to its original height above water-level, which was done at the same time, costing $473.85. Of the appropriation of $15,000, June 14, 1880, but $5,000 were by the terms of the act allowed to be expended on the improvement of Saginaw River above Bay City, and as this allotment was nearly exhausted in October, 1880, further repairs were discontinued, and the balance used in redredging the channel at the lower end of the bar, 60 feet wide and 12 feet deep, under contract with T. M. Hubbell, at a cost of $16 per hour for an outfit, which included double handling of the dredged material, the latter being thrown by means of a clam-shell dredge from deck-scows over the upper section of the beam wall. This work was done in one hundred and forty-nine and one-half hours, and cost $2,392.

With the aid of the appropriation of $10,000, made March 3, 1881, a new work was projected and built, which consisted of a slight pile and edging structure, 1,000 feet long, in prolongation of the United States revetment, principally for the purpose of inducing a scour over the channel heretofore barred. This extension was constructed in June and July, 1881, at a cost of $1,921.90, or nearly $2 per linear foot. A portion of the same appropriation was used in further repairs to the Carrollton Works; the beam-wall, which had settled still more during the spring freshet of 1881, was built up again by adding plank to the top, at an expense of $723.88, and some minor repairs were made on the revetment pier, costing $218.40.

Up to this time (the summer of 1881) all the efforts of the Engineer Department had been in the direction of making and maintaining a navigable channel of 10 feet depth of water, and all the dams and revetments projected and constructed during the preceding eight years were intended to aid in the attainment of that object. In what measure these efforts proved successful may be judged from the facts above related. Although the original project could not be considered as completed, at the instigation of the East Saginaw Board of Trade a new and more extensive project was proposed, and the United States Engineer Department requested to make an examination of the river, from its head to Bay City, with a view of making and maintaining a navigable channel of 12 feet in depth. This preliminary examination and survey was made in the autumn of 1881, under the direction of Major Harwood, and a detailed report and project with estimate of cost presented by him to the Chief of Engineers under date November 29, 1881. All operations under the old project were necessarily suspended with the exception of some minor repairs to existing works, which were made in July, 1882, at an expense of $846.12. August 2, 1882, the sum of $125,000 was appropriated, $60,000 of which to be expended on the improvement of the river above Bay City, including the Carrollton Bar. Major Harwood's survey and projects are shown in Figure 4 of the accompanying drawing, Sheet VI. These were submitted to a Board of Engineer Officers, whose report to the Chief of Engineers, under date October 19, 1882, may be found in the Annual Report of 1883, Part II, on page 1863. The conclusions of this Board regarding the further improvement of the Carrollton Channel under the new project were against the construction of any new revetments as channel protections generally, and the extension of the existing revetments to deep water in particular; and it was decided that a channel of 12 feet depth and 200 feet wide could and should be maintained by dredging only. In lieu of the extension of the piers, the construction of a dam across the Carrollton Bar, connecting the beam-wall with the westerly shore, was determined upon, and is included in the general project. This, however, has not yet been built, and serious objections and emphatic protests on the part of the mill-owners along the Carrollton village front, which were made when a site was selected, will probably interfere with its construction.

In the proposition submitted by Maj. F. U. Farquhar, Corps of Engineers, United States Army, for the expenditure of the allotted $60,000, it was unfortunately overlooked that the existing works at Carrollton required improvements or reinforcement in view of the close proximity of the proposed 12 foot channel, and no provision was made in that direction.

Dredging was begun at Carrollton in the fall of 1883, and during the fiscal year 28,825 cubic yards of sand were removed, at a cost of 37½ cents per cubic yard, and a total of $10,809.38. All the dredged material was deposited behind the lower end of the United States revetment and its extension, and the weight of the sand as well as the manner in which it was thrown over, caused considerable damage to these structures. A map of soundings taken through the ice, under your direction, in February, 1884, shows a good channel of 12 feet depth and about 100 feet wide. Figure 5 of the accompanying drawing, Sheet VI, is a reduced copy of this map, omitting soundings and substituting curve lines to correspond with other figures.

This completes the history of the Carrollton Bar down to the beginning of the fiscal year, which forms the subject-matter of this report. Adding the amount of dredging done during the year just closed. The following table will give a summary of dredging operations at Carrollton under the direction of the United States Engineer Department to date:

Month and year.	Width.	Depth.	No. cubic yards.	Price.	Amount.
	Feet.	*Feet.*			
1875–'76	......	......	33,643	$0 37½	$12,447 [illegible]
August, 1877	90	10	3,871.5	35	1,[illegible]
November and December, 1878	100	10	7,286	14	1,[illegible] 04
September and October, 1879	100	10	11,113	11	1,222 [illegible]
October, 1880	60	12	13,000	....	*2,[illegible]
1883–'84	100	12	28,825	37½	10,[illegible]
1884–'85	100	12	43,645	27½	12,0[illegible]
Total	......	......	141,383	....	41,2[illegible]

* Estimated for 149½ hours, at $16 per hour, $2,392.

The total amount of sand dredged being 83,000 cubic yards in excess of the original estimate which was made in 1873, in connection with the proposed permanent removal of the obstruction to navigation, it follows that the anticipations in that direction have not been realized. It will be readily seen that the construction of the United States revetment alone did not tend to produce a scour sufficient to maintain a navigable depth when made. The addition of the beam-wall effected this, but to a greater extent than it was designed or required, owing to its close proximity to the revetment, with which it forms a canal much narrower than the width of the river above and below the Carrollton Bar, where deep water has always been found. It seems to me that if the reveutment was extended to deep water, as Captain Lee suggested in 1876, and the beam-wall prolonged in like manner so as to fence in the tail of the bar, a 12-foot channel would be maintained by the natural scour through many seasons.

I therefore respectfully recommend a reconsideration of the present approved project, and the construction of revetments in extension of the existing works to deep water. Estimating the cost at $5 per linear foot, this would involve an expense of $10,000. In order to prevent the bar within these extended boundaries of the channel from moving to a point further below, it will be necessary to deepen the channel to 12 feet at the same time that the pier extension is taken in hand. The quantity to be removed in this reach of the river can only be conjectured, and I therefore approximately estimate it at 60,000 cubic yards, which, at 30 cents per cubic yard, makes the cost of dredging $18,000.

THE "ZILWAUKIE BAR,"

which is located at the head of Crow Island, about 3½ miles below East Saginaw, was and is considered next in importance in the several projects for the improvement of the Saginaw River, the Carrollton Bar being first. In the accompanying drawing, Sheet V, I have reproduced, on a uniform scale, five maps of surveys which were made at about the same time and under the direction of the same engineer officers, as those shown in corresponding figures on the Carrollton charts, and therefore omit details in regard to these particulars.

The original project for the permanent improvement of the channel at the Zilwaukie Bar was made in 1876, and includes the construction of a revetment about 1,300 feet long, having its initial point on the east shore of the river, opposite Bliss's Mill, and extending down-stream on an easy curve, so that its lower end covers the up-stream entrance to the so-called Oneida Channel. This channel is an arm of the Saginaw River, between which and the main channel along the Zilwaukie village front Crow Island is situated. This Oneida Channel is said to have been navigable by light-draught vessels in early times, and preferred by this class of boats because it is straight and offered a shorter route past Crow Island. An old saw-mill on the east shore, opposite the head of Crow Island, which had formerly belonged to a firm of capitalists from Oneida, N. Y., gave the name to the channel. This mill had changed hands and was being rebuilt and put in operation by Messrs. Sibley & Bearinger when, in 1877, it was proposed to carry out the plan of improvement and to construct the revetment on the line projected. As it would have been an injury to their business to close up the up-stream entrance to their mill-dock and log-boom, this firm objected to the original line of revetment, and a new site was selected, shown on Figure 2. This wing-dam, 905 feet long, was built in the fall of 1878, at an expense of $3,319.96, or about $3.66 per linear foot. Its up-stream end or head was located 50 feet from the Oneida mill dock front, extended, a sufficient space for the convenient passage of vessels into and out of the water fronts of the mill property.

The Zilwaukie Bar, which had originally been a shoal in continuation of the head of Crow Island in a southwesterly direction (see Figures 1, 2, and 3), was partially removed by dredging in the autumn of 1879. A uniform depth of water of 10 feet was made over an area, the easterly boundary of which was on a line (shown in Figure 3) drawn from the head of the pier on an angle deflecting westerly therefrom; 16,388 cubic yards of sand were excavated, at 11 cents per cubic yard, costing $1,802.68. The result of this dredging and the utility of the wing-dam in maintaining the channel thus made is fully set forth in the Annual Report of 1880, Part III, on page 2041, to which I beg leave to refer.

Subsequent examinations and surveys, especially those of 1881 and 1884 (Figures 4 and 5), show the effect of a scour along the middle and lower reach of the wing-dam, sufficient not only to maintain a channel on that side of the river, but to also remove large quantities of sand without the aid of a dredge. However, these examinations also establish the facts that there is a strong current setting in behind the revetment, especially under the force of a southwesterly wind; that a new bar has formed and is continually growing in the axis of the river, directly opposite the head of the pier, and that the channels on each side of this shoal, the old one west of it, and the improved channel between it and the dam, are in danger of being filled up as the bar increases in superficial dimensions.

During the years 1880–'82 several improvements were made along the east shore of the river in this vicinity. Messrs. Melchers & Nerreter purchased a site and built a shingle mill and salt block immediately above the entrance to the Oneida Channel, in the year first mentioned, and soon after Messrs. Tyler & Son located a similar enterprise a short distance further up-stream, opposite the saw-mill of A. T. Bliss & Co. Both these shingle mills were provided with docks and log-booms projecting out into the stream, and made connection for the purpose of facilitating log supplies with a branch railroad-track of the Flint and Pere Marquette Railroad, by means of slips and canals extending from the shore line at right angles thereto to a wide ditch or canal dredged through the marshy land along the west side of the railroad track, the excavated material forming its embankment. Now, in order to provide a means for preventing the river current from dividing at the head of the pier, and to guide it along the front of the same, thus insuring an increased scouring effect for the benefit of the channel, it appeared necessary to carry out, as near as may be, the original plan of revetment shown at Figure 1, by building a revetment with its head resting against Tyler & Sons' shingle dock, and its lower end lapping the entrance to the Oneida Channel, leaving sufficient opening for the accommodation of shipping doing business with the Saginaw Lumber and Salt Company (successors to Sibley & Bearinger). This plan of improvement was proposed by Maj. F. Harwood in his report dated November 29, 1881, and is shown in Figure 4 of the accompanying drawing. In conformity with the decision arrived at regarding the improvement of the Carrollton Channel, this plan was rejected by the Board of Engineer Officers to whom it was submitted, but, in lieu thereof, the Board included in their approved project the construction of a dam across the Oneida Channel at some point below the saw-mill of the Saginaw Lumber and Salt Company. When, however, in pursuance of this project, a site was selected for this dam, in January, 1883, preparatory to making estimate of cost of construction, a vigorous protest was entered by said company, and the dam has not been built.

Under the appropriation of August 2, 1882, the channel was dredged along the boom, on the west side of the river, in the spring of 1884; 14,200 cubic yards were then removed at a cost of 37½ cents per cubic yard, or a total of $5,325. This cut has since filled up, as above stated.

The reasons which I have advanced, while submitting the necessity for the extension of the piers at Carrollton, apply with equal force in this connection. If the current, which now passes behind the wing-dam, can, by the interposition of a revetment, be guided along the channel side, an increased scouring effect will be produced to aid in maintaining a channel after it is dredged to 12 feet depth. I therefore respectfully recommend that, before there is any more dredging done on the Zilwaukie Bar, a revetment be constructed from the east shore between Tyler & Sons' and Melcher & Nerreter's shingle-mill property, at right angles to the axis of the river to their boom limits, thence (leaving an opening for logs at this point) down-stream on an easy curve out into the channel to within about 100 feet from the head of the wing-dam, substantially as shown on the drawing, Sheet V. The plan of construction may be similar to that of the wing-dam; but I believe that in this locality, where there will be deep water on both sides (instead of a bank of sand resting against it as at Carrollton), a plank-beam wall would be as strong and efficient as required. Either plan will cost less than $5 per linear foot. There will be 600 feet of revetment required, costing $3,000. The amount of dredging necessary to give a channel with a uniform depth of 12 feet can only be approximated, on account of the continual growth of the shoal above mentioned. I therefore estimate it at 36,000 cubic yards, which will require the expenditure of $10,800.

DUMPING GROUNDS.

Since it has been determined that all dredged material shall be deposited on shore or carried out into Saginaw Bay, the problem how to dispose of the sand removed from the channel along the upper reaches of the river most economically and beyond the possibility of ever returning to the river-bed, has not hitherto been solved satisfactorily, and I beg leave to invite your attention to this important subject.

In the specifications governing contract work under the present approved project, the selection of the places of deposit for dredged material was left entirely with the contractors, and they were to assume all risk and expense of placing the sand upon the bank of the river. At the same time it was specially provided that "the material will be deposited in such manner that after settlement the foot of the slope will in no case be nearer to the low-water mark of the river at that point than 20 feet, nor so situated that it will be liable to be washed into the river again during high water or freshets." Leaving out the question whether sand may not be washed into the river again, even a distance of 20 feet, when the river overflows its low and swampy shores for miles, the above-mentioned restrictions must necessarily make the selection of suitable dumping grounds difficult, if not practically impossible. If these conditions had been strictly observed in the conduct of dredging operations during the last two years, it is doubtful whether any work of improvement could have been carried on at all; and it is a fact, which can easily be proved by only a casual examination of the places of deposit, that these provisions were not insisted upon, with but few exceptions. The greater the difficulty of selecting suitable dumping grounds the higher a price will be demanded by contractors per cubic yard of dredging, as will be seen by the difference in the cost of this service shown in the tabular statement of work done at Carrollton: In 1878 and 1879, when dumping grounds were selected by the Government, dredging was done for 14 and 11 cents, respectively, while during the last few years it cost 37½ and 27½ cents per cubic yard. The difference between these rates, or about 20 cents, may be estimated to be the price paid for the proper disposition of dredged material.

Assuming the quantity of sand to be dredged, before the present project can be considered as completed, to be not less than 500,000 cubic yards, it will cost $100,000 to place the material upon the bank of the river, or nearly as much as the dredging alone can be done for at present ruling prices.

During the deliberations of the Board of Engineer Officers having the present project for the improvement of the river under consideration, the advisability of doing all the dredging required by means of a complete plant owned and operated by the Government was discussed, though not adopted; and I now believe that a similar plan, simply for taking care of the dredged material alone, if carried out, would not only be a practical solution of this difficult problem, but it would also reduce the price paid for dredging to a low figure.

Instead of using clam-shell derricks and lifting the sand from flat scows onto the shore, I would recommend the adoption of a sand-pump and pipe-line, such as are used for dredging purposes on Western rivers. By this means the sand may be carried long distances from shore to a safe place of deposit. It must be borne in mind that all the low land along the river shore is owned by private parties and cannot be trespassed upon without their consent; but it will not be any more difficult for the Government to obtain permission of owners to fill up and raise large areas of their now useless swamp land than it is for the dredging contractors under the present system for the purpose of piling up the sand along the shore. If it should be determined that hereafter sand must be deposited on land a long distance from shore in the manner above suggested, a provision to that effect might be inserted in the specifications for future contracts, leaving the selection of the dumping ground, as well as the method of reaching it, to the contractor; but this would not materially reduce the present price for dredging, inasmuch as the contractor who first supplies himself with the necessary plant would include the cost of the machinery in his first estimate and bid, and, until competition is created, enjoy a monopoly. Hence I earnestly believe that the Government should own and operate the machinery for depositing the dredged material in places of its own selection, a plan which would result in a considerable saving of expense in the prosecution of the work of improvement.

SNAGGING.

While the sand-bars and shoals in the river are obstructions to navigation particularly affecting heavily-loaded vessels, yet not only these, but all light-draught steamboats, lighters, and tugs are in constant danger of being damaged or sunk by coming n contact with the numerous snags which are found scattered throughout the whole ength of the river, and accidents happening in this way are of frequent occurrence and most expensive to the vessel owner. These snags consist of trees, stumps, or logs, brought down-stream with the rafts which are made up in the various tributaries of the Saginaw River. The trees and stumps collect in the store booms and are allowed to escape therefrom, or perchance are pushed into the stream by the raftsmen for the purpose of clearing their booms. When saw-logs on the way down the river show signs of decay or otherwise become worthless, the raftsmen cull them and set them adrift. In a very short time the decayed end of the log sinks to the bottom, while the other end floats at or near the surface of the water in the direction wind or current may move it. The owners of the regular steamboat line between Saginaw and Bay City report the breakage of their wheels and rudders, and similar damages caused by contact with snags, as a large item of expense each season. During the past eight years, to my personal knowledge, the complaints about snags, and urgent requests of steamboatmen to expend a small sum of the river appropriation in snagging, were made as regular as each season came and went. In 1879, as an experiment, a contract was let, after competition, for removing snags and sunken piles from the channel at the low rate of 50 cents per saw-log, and $1 per pile. The contractor was required to take all the snags and to either deposit them in certain places on shore or destroy them; also to make as many trips from one end of the river to the other as might be necessary to keep the river clear of snags during the season. The first trip was made during the latter part of May, 1879, and 148 saw-logs and 7 piles were removed at an expense of $81. A second trip became necessary in July of the same year, during which 141 snags and 1 pile were taken up for $71.50. The expense of superintendence and inspection under this contract nearly equaled the cost of removal, and as it was found that new snags collected in the channel constantly during the season of navigation, and no authority of law existed to prevent the cause of such accumulation of snags (whether by accident or the negligence of log-drivers), it was deemed best to discontinue snagging by the contract system, and though several other plans have been suggested, none have since been attempted.

I am convinced that to keep the river free from snags during the season of navigation is just as important and as great a benefit to navigation as the work of dredging to obtain an increased depth of channel, and a small amount of the annual appropriations should be set apart for this purpose. Most of the methods which have been suggested to me by parties interested are objectionable, inasmuch as they lacked the essential item of strict Government inspection and control. Without the latter the work should not be done, whether the contractor is paid by the month, each trip, or by the number of snags removed, because the most of the snags are saw-logs of more or less value, the taking of which by private individuals constitutes a serious offense under the State law, and a license given by the General Government might lead to the arbitrary and indiscriminate removal of loose saw-logs constantly collecting along the river shores, and which cannot properly be classed with snags.

After careful consideration of the methods proposed, I have come to the conclusion that the most economical and efficient way of snagging the river would be about as follows: A small steam tug or launch should be purchased by the Government, and operated under the direction of the agent in charge of the river improvement, this tug to be provided with adjustable hoisting apparatus, grappling irons, and tackle. Once a month, or as often as snags are reported to have lodged in the channel, the captain of the tug should make a trip from one end of the river to the other, and operate the tug as snag-boat, and be required to keep a diary, and make weekly and monthly reports of operations, same as dredge inspectors now do.

A small allotment from each annual appropriation might be made from which to defray the expense of the snagging operations, but I believe the service can be made nearly self-supporting, inasmuch as the greater portion of the snags can be utilized by cutting into plank and edgings for use in necessary repairs of revetments, thereby saving a considerable expense in that direction. The steam-tug, when not employed in snagging, may be used for transportation of men and material on repair work, and in connection with surveying and sounding the channels. A small tug, well adapted for this purpose, can be purchased for $1,000; the adjustable hoisting machinery, &c., will cost not to exceed $200, and the running expenses, including fuel and two men, amount to $150 per month; during the time the tug is used for snagging, two extra men will be required, who may be hired by the day. For a season of six months, therefore, the annual cost of this service will not exceed $1,000, half of which can be recovered by utilizing the snags as above described.

REPAIRS.

Although the present approved project makes no reference to the existence and possible utility of the revetments at Carrollton and Zilwaukie, it seems to me that some provision should be made to keep them in repair. Even if this project is not reconsidered and amended in accordance with my recommendations, the facts herein above related cannot fail to lead to the conclusion that the usefulness of these structures is sufficiently proved to warrant the expenditure of an amount necessary to prevent their entire destruction. In this connection I beg leave to refer to my report dated May 20, 1885, in which an accurate description of the existing works is given, together with estimates of cost of necessary repairs, and respectfully recommend that the aggregate amount of my estimate, $9,000, be included in the sum required for continuing the improvement of Saginaw River during the fiscal year ending June 30, 1887, and to be made available immediately after the passage of the act, if possible.

Trusting that my recommendations regarding amendments of the present project may meet with your approval, I beg leave to submit the following recapitulation of amounts necessary to carry out the plans proposed, and which may be profitably expended during the fiscal year ending June 30, 1887, or sooner, if Congress can be prevailed upon to make the appropriations immediately available.

Repairs to revetments at Carrollton	$9,000
Extension of revetments at Carrollton	10,000
Dredging at Carrollton	18,000
Revetment at Crow Island	3,000
Dredging at Crow Island	10,800
Snag-boat and appurtenances	1,200
Operating expenses of snag-boat one season	1,000
Continuing dredging opposite and below Bay City	25,000
Dredging at other places for immediate relief	2,000
Total	80,000

Seven sheets of drawings, which are herein referred to and intended to accompany this report, are in course of preparation, and will be forwarded to you as soon as they can be completed. Appended hereto please find a table of commercial statistics, which is compiled from the fourth annual report of the East Saginaw Board of Trade, and illustrates the magnitude of the commerce of the Saginaw Valley.

Very respectfully, your obedient servant,

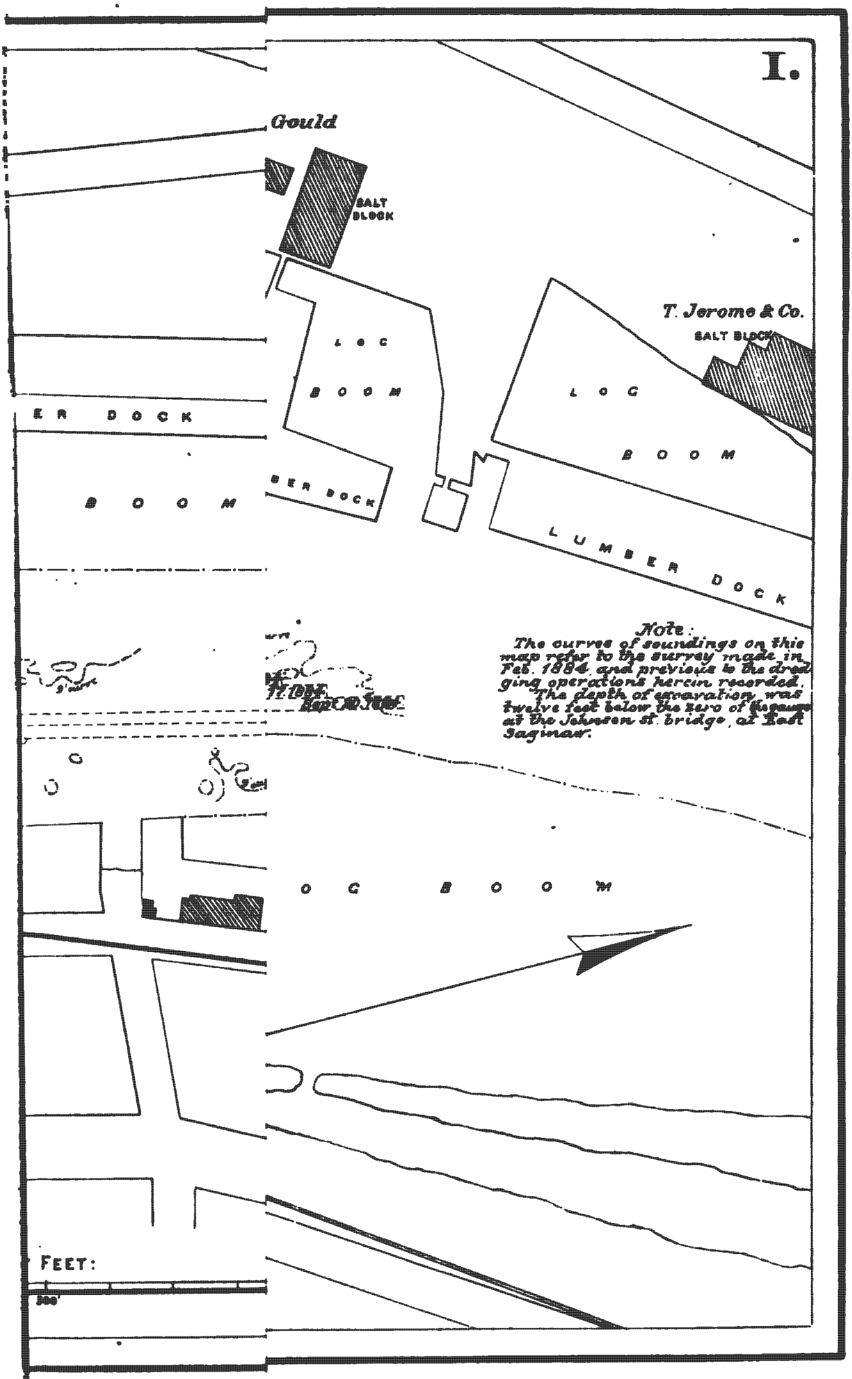
B. H. MUEHLE,
Assistant Engineer.

General O. M. POE,
Lieut. Col. of Engineers, U. S. A.

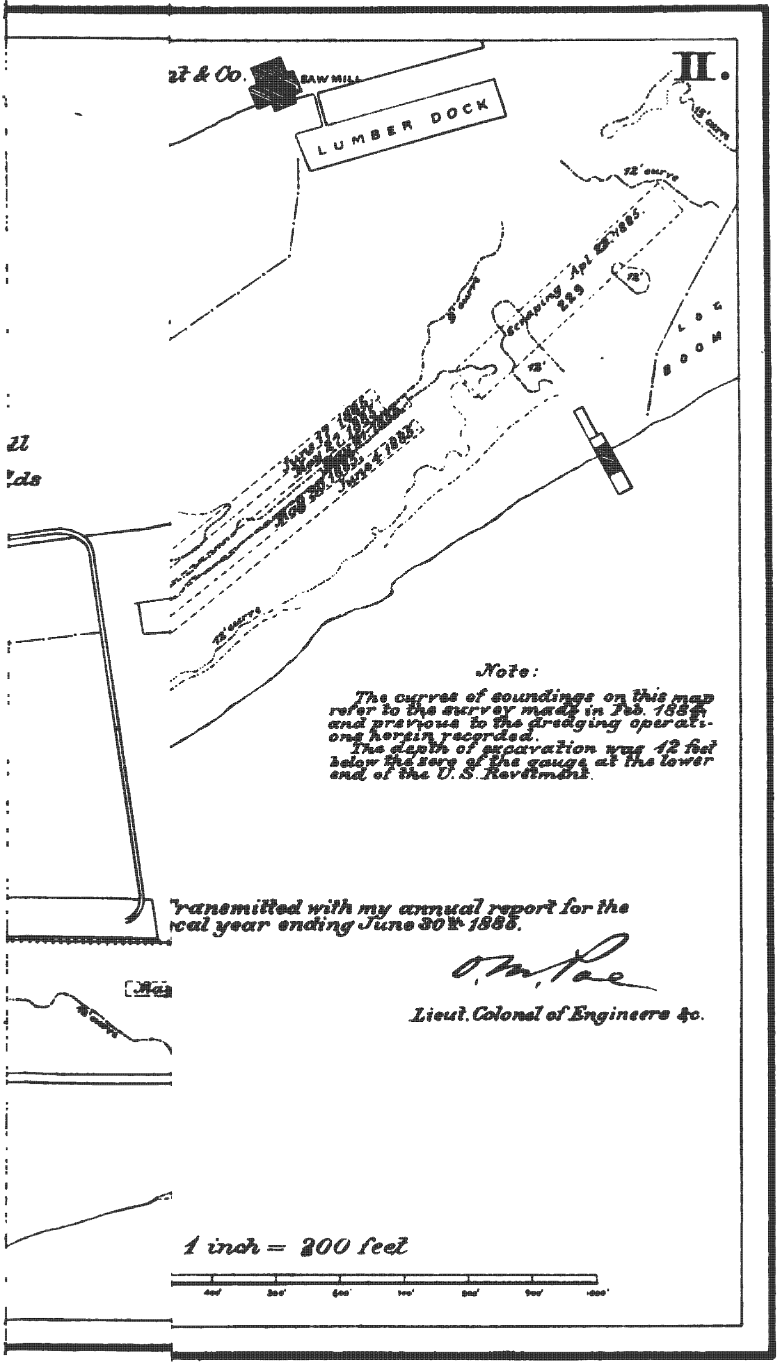
Table of commercial statistics showing the principal business done on Saginaw River during the last twenty years.

Year.	Logs brought to Saginaw River from the tributaries of bay and river.	Lumber product of seventy saw-mills on Saginaw River.			Shingles cut in twenty-five shingle-mills.	Lath product
		Manufactured during season.	Total on dock at end of season.	Sold on dock at end of season.		
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Pieces.*	*Pieces.*
1865	188, 657, 072	250, 639, 340	44, 453, 000	22, 362, 000	....	....
1866	257, 170, 883	349, 767, 834	44, 415, 700	14 211, 000	....	48, 62[illegible]
1867	335, 884, 062	423, 963, 190	60, 969, 771	17, 435, 571	90, 958, 000	63, 876, [illegible]
1868	870, 657, 100	451, 395, 225	67, 401, 017	13, 402, 090	104, 104, 500	61, 478, [illegible]
1869	425, 883, 408	523, 500, 830	93, 831, 614	14, 520, 000	119, 843, 500	51, 754, [illegible]
1870	522, 985, 720	576, 726, 606	130, 4?2, 190	47, 862, 000	178, 570, 000	61, [illegible]
1871	531, 538, 116	529, 682, 878	75, 590, 511	33, 576, 000	187, 691, 000	62, [illegible]
1872	538, 420, 887	602, 118, 980	152, 822, 553	40, 928, 200	159, 001, 750	76, 951, [illegible]
1873	573, 281, 770	619, 877, 021	222, 071, 665	30, 893, 000	218, 304, 550	80, [illegible]
1874	523, 614, 163	573, 632, 771	213, 152, 663	23, 135, 000	208, 489, 500	73, 675, [illegible]
1875	529, 741, 701	581, 558, 273	223, 202, 108	26, 505, 578	124, 030, 240	73, 200, [illegible]
1876	539, 211, 111	583, 95?, 771	224, 546, 657	30, 000, 000	204, 346, 725	72, 708, [illegible]
1877	591, 164, 457	640, 110, 231	245, 935, 522	23, 511, 666	167, 806, 750	72, 514, [illegible]
1878	496, 079, 674	574, 162, 757	217, 572, 383	18, 640, 280	153, 989, 750	53, 296, [illegible]
1879	667, 181, 286	736, 106, 000	221, 864, 595	85, 647, 837	218, 934, 000	65, [illegible]
1880	809, 674, 278	873, 047, 731	295, 870, 633	92, 103, 596	241, 075, 160	63, [illegible]
1881	761, 606, 570	976, 320, 317	281, 990, 929	118, 605, 117	304, 925, 500	65, 963, [illegible]
1882	878, 725, 420	1, 011, 274, 905	309, 079, 999	105, 073, 000	295, 046, 500	94, 708, [illegible]
1883	735, 368, 792	938, 675, 078	376, 037, 075	134, 042, 692	242, 026, 000	106, 132, [illegible]
1884	771, 195, 083	964, 435, 984	458, 046, 848	51, 530, 000	261, 266, 750	127, 346, [illegible]
Totals	11, 037, 541, 617	12, 781, 002, 722	3, 997, 786, 433	944, 101, 527	3, 480, 625, 175	1, 387, 296, [illegible]

Salt was manufactured during the season of 1884 by eighty-eight salt companies having seventy-nine steam and sixteen pan blocks, and 4,500 solar salt covers, yielding 2,373,319 barrels of salt.



Note:
The curves of soundings on this map refer to the survey made in Feb. 1884 and previous to the dredging operations herein recorded.
The depth of excavation was twelve feet below the zero of the gauge at the Johnson St. bridge, at East Saginaw.



Note:

The curves of soundings on this map refer to the survey made in Feb. 1885 and previous to the dredging operations herein recorded.

The depth of excavation was 12 feet below the zero of the gauge at the lower end of the U.S. Revetment.

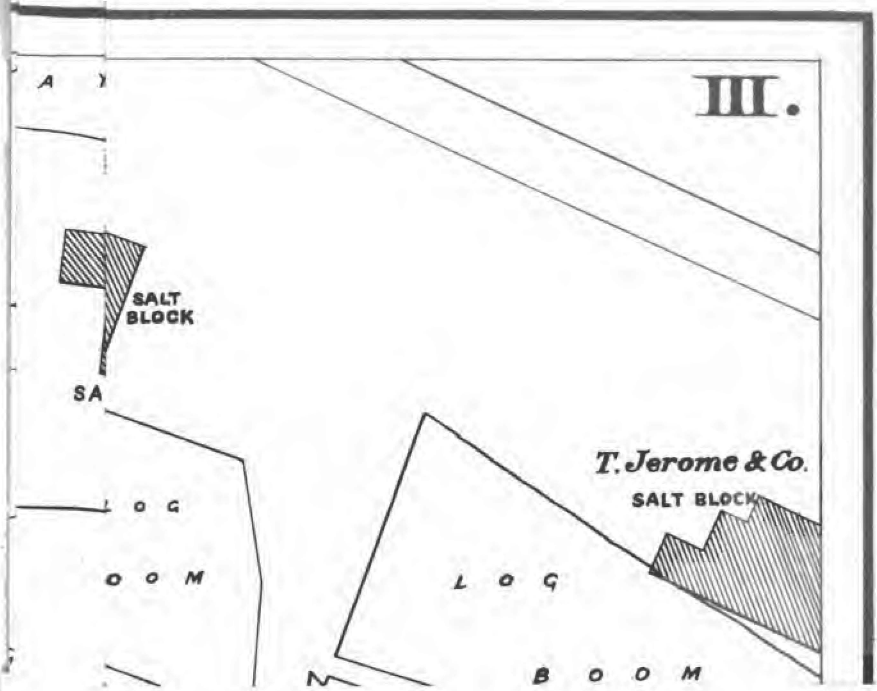
ransmitted with my annual report for the cal year ending June 30th 1885.

O. M. Poe

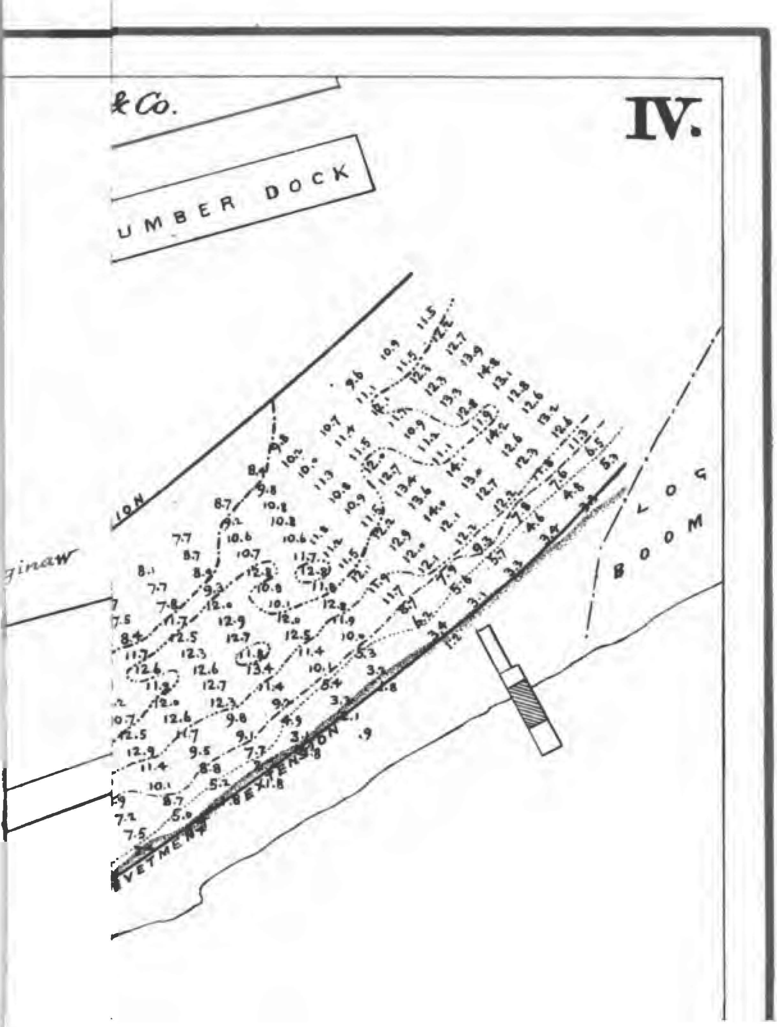
Lieut. Colonel of Engineers &c.

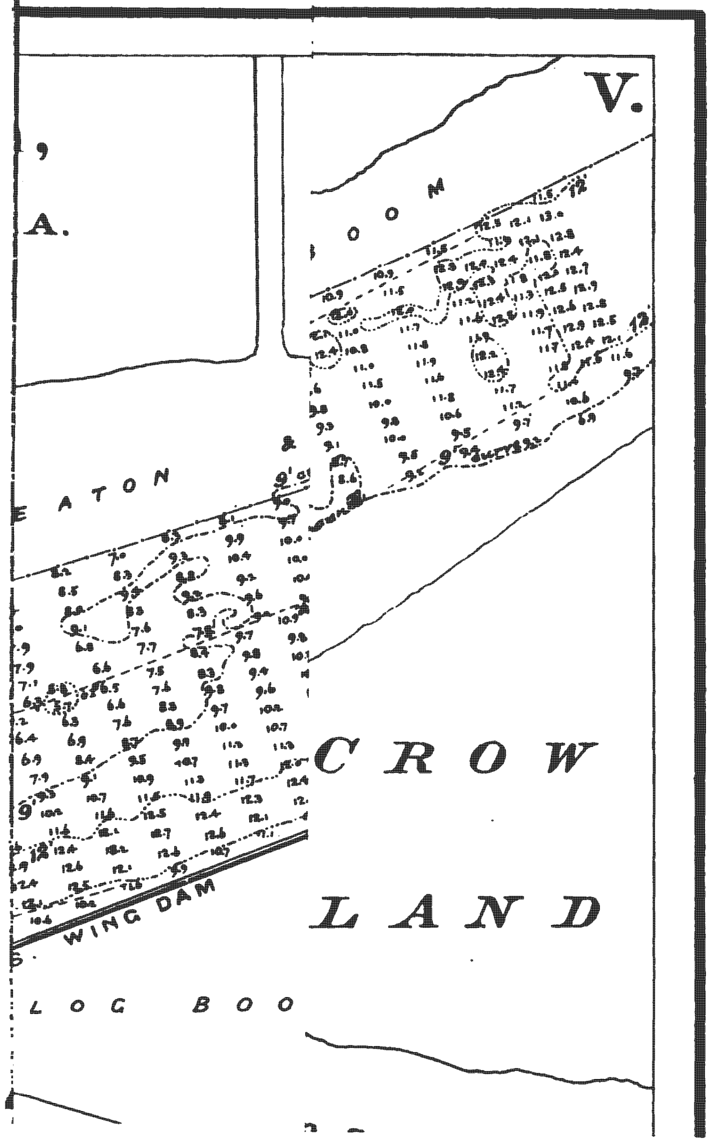
1 inch = 200 feet

III.



IV.




V.
A.
OOM
EATON
CROW
LAND
WING DAM
LOG BOO

L L 9.

MPROVEMENT OF HARBOR OF REFUGE AT SAND BEACH, LAKE HURON, MICHIGAN.

The present project for this improvement was adopted in 1873. It onsists of a breakwater constructed of timber cribs filled with stone, nclosing an area which is to be deepened, where necessary, by dredging. Its object is to afford a harbor of refuge to the vessels engaged in the avigation of the Northern and Northwestern Lakes, when caught by eavy weather near the dangerous Point Aux Barques. Previous to 876 vessels so caught were compelled to run a distance of 60 miles and nd refuge in Saint Clair River. After the subsidence of the gale, those ound upward had to work their way back again.

At the beginning of the fiscal year there were no contracts in force, ll those previously reported having been completed, and the funds, xcept the small amount required for the custody and care of the harbor, were exhausted.

It was not practicable to go through all the preliminaries and begin perations under the appropriation of $75,000 made by the river and arbor act of July 5, 1884, until August. In order to utilize the best portion of the working season, some 35,000 feet B. M. of timber were purchased in open market, and, together with such timber and iron as had been left over the previous season, used in making a commencement upon the superstructure of the unfinished cribs of the main pier, the team launch being employed as a tug. The operations of the diver upon the foundations were begun at the same time.

The time was thus filled up until the delivery of materials under contract could be begun.

Four contracts were entered into as follows, viz:

(1) With Brooks, Joslyn & Co., dated August 29, 1884, for furnishing imber and plank.

(2) With George Talbot, dated August 29, 1884, for furnishing one dredge, one tug, and two dump-scows.

(3) With Calvin Currie, dated August 29, 1884, for furnishing one tug.

(4) With W. H. McCurdy & Co., dated September 4, 1884, for furnishing iron bolts, plates, and spikes.

The bowlder stone required for filling cribs was purchased in the open market in the manner heretofore reported, that is to say, from the people in the vicinity, most of whom were fishermen, who picked up the bowlders during their leisure time and delivered them in the cribs at $5, $5.25, or $5.50 per cord, depending upon the situation of the pockets into which they were placed. The low prices were advantageous to the Government, and the money spent amongst the people, without the interposition of a contractor as a middleman, was, as heretofore, very satisfactory to them.

With the material obtained as above and labor, also hired in the vicinity, the superstructure of the fifteen unfinished cribs of the main pier was completed. One hundred linear feet of superstructure was also built upon the north end of the south pier during the season of 1884.

The operations of the diver upon the foundations were continued until October 10, 1884. The crib-construction work was closed for the season November 15.

The dredge commenced work September 10, and continued until December 3, when it closed for the season.

The contract with W. H. McCurdy & Co., for iron bolts, &c., was satisfactorily completed September 30.

The contract with Brooks, Joslyn & Co. was extended to May 1, 1885.

The contracts with George Talbot being limited by the amount expended, and that with Calvin Currie by the requirements of the work, were continued into the season of 1885.

The lights kept by the Engineer Department to mark the north entrance were discontinued for the season December 1. The harbor buoys, also kept by the Engineer Department, were taken up and stored November 26 and 28 and December 3, and the engineer lights at the main entrance were discontinued December 18.

Favorable ice forming by the latter part of January, 1885, an examination of the unsurveyed portion of the harbor was made through holes cut in the ice; in doing which 19,220 soundings were taken. These were reduced and platted before the opening of the season of 1885.

Operations were resumed May 1, 1885, on both the dredging and crib-work, and have been continued to the close of the fiscal year without interruption.

The contract with Brooks, Joslyn & Co. was extended to June 1, but the whole amount of timber was not delivered until the latter part of June. This was of advantange to the Government rather than otherwise, and I haverecommended the formal extension of the contract to July 1 and the payment of all retained percentage. (Extension authorized by the Chief of Engineers under date of July 8, 1885.)

The outside wainscoting and plating on the main pier have been put in place, and the under-water bolts driven by a swing-hammer. The inside sheeting is all in place and spiked under water, and the oak wale bolted on. The face-wall has been completed on the main pier; 200 linear feet of face-wall have been built on the east end of the west pier, and 60 linear feet on the north end of the south pier. Two moving buoys, for the use of rafts, have been placed on the west side of the harbor. They are anchored to rock bolts in the lake bottom.

Examination of the crib foundations, made by Assistant Engineer C. P. Gilbert in the diver's dress, show that the completed work has not been disturbed, and that the dredged material, used as riprap, stand the action of heavy seas when it has been properly placed. It is now quite well demonstrated that the plan of riprapping the breakwater by using a small amount of dredged material carefully placed by divers is successful, and, as compared with the plan of using a large amount of stone thrown in at random, can be accomplished at less than one-sixth the cost. The plan now followed is the result of many experiments, some of which were complete failures.

The dredge has completed the removal of the middle shoal.

The operations of the fiscal year, together with the results thereof, may be summarized as follows:

At the beginning of the year the entire substructure was in place, but 2,925 linear feet of superstructure were wanting. Of this amount, 1,075 feet were built during the year, leaving at its close 1,950 feet yet to be built, all of which is to go on the south pier.

The dredge worked 997$\frac{5}{12}$ hours, removing 27,740 cubic yards of material, at a cost (exclusive of superintendence) of $7,879.57 or 28.4 + cents per cubic yard.

Of face-wall, other than that included in the 1,075 feet of superstructure above mentioned, 200 linear feet were built on the east end of the west pier and 60 feet on the north end of the south pier.

Many minor details were completed, as before related. The total expenditure for the year was $51,535.79, leaving an available balance of $24,521.55.

Two cases of violation of the "rules and regulations" for the government of the harbor have been reported, as provided by law. They were tried before the United States district court at Detroit, and in both cases the offending parties were convicted and fined. This is one of the salutary effects of having a custodian at the work, who is charged by law with the duty of making complaint and bringing offenders to justice. I cannot too strongly commend the advantageous results of the law in providing for the proper care and custody of the harbor.

The custodian's salary and all other expenses attending the performance of his duties are now paid from the special appropriation for continuing the improvement. It would be better to provide by law for defraying these expenses from an indefinite appropriation, as is done in the case of the Louisville and Portland Canal, the Des Moines Rapids Canal, the Saint Mary's Falls Canal, and the Saint Clair Flats Canal, because the exhaustion of the special appropriation and failure to make another would necessarily involve suspension of the custodian's duties, and they are too important to the interests of the commerce availing itself of this harbor to be intermitted, if it can possibly be avoided.

The project for the present season's work will leave only a sufficient balance to provide for operating and care of the work to the close of the fiscal year ending June 30, 1886.

The next appropriation should be expended in building a superstructure on the unfinished portion of the south pier, and if large enough to justify doing so, in dredging inside the harbor.

The dimensions of the work now in place are as follows:

	Linear feet.
West of north entrance, west pier	1,500
Between north and main entrance, main pier	4,680
South of main entrance, south pier	1,950
Total	8,130
Cribs without superstructure, south pier	1,850

Total material in place in the work:

Timber and plank	feet, B. M.	17,389,475
Iron	pounds	1,404,828
Stone	cords	55,046

The harbor has but little local importance, but is of great value to the general commerce of the lakes. The extent to which it has been utilized by this commerce is shown by the following tables, 1, 2, and 3. From Table No. 2 it is seen that 1,091 vessels, with an aggregate of 302,299 tons, sought refuge in the harbor during the fiscal year ending June 30, 1885.

The original estimate of the work was		$1,442,500 00
Of which there has been appropriated the sum of	$975,000 00	
Received from sale of fuel	200 63	
		975,200 63
Difference		467,299 37
Estimated amount required to complete the work		100,000 00

The estimate of $100,000 required to complete the work is divided as follows:

Superstructure, south pier	$30,000
Dredging, repairs, custody, &c	70,000
Total	100,000

The older portions of the timber work are, as previously reported, in better condition than could have been expected, but the renewal of parts of the superstructure must become necessary before long, and experiments should be made with a view to the best plan for doing this, economy and durability being considered.

A tracing is transmitted herewith showing the condition of the improvement on June 30, 1885.

The work is located in the collection district of Port Huron, which is the nearest port of entry. There is a light-house on the northwest angle of the main breakwater, and a light on each side of each entrance. A light-house is under construction on the northern side of the main entrance. Upon its completion a rearrangement of the lights will be made, dispensing with one.

Money statement.

July 1, 1884, amount available		$1,031 08
Received from sale of fuel		26 26
Amount appropriated by act approved July 5, 1884		75,000 00
		76,057 34
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$45,375 88	
July 1, 1885, outstanding liabilities	6,159 91	
		51,535 79
July 1, 1885, amount available		24,521 55
Amount (estimated) required for completion of existing project		100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

TABLE No. 1.—*Tabular record of vessels taking refuge in the harbor of refuge, Sand Beach, Lake Huron, from June 30, 1884, to June 30, 1885.*

Direction of wind at time of entering.	1884.						1885.		Total.
	July.	August.	September.	October.	November.	December.	May.	June.	
North:									
Steam	5	7	10	9	6	......	11	19	67
Sail	8	13	4	3	2	......	10	5	45
Tow	4	9	6	11	......	......	13	17	60
									172
Northwest:									
Steam	35	14	17	23	16	1	6	......	112
Sail	19	13	8	4	7	......	......	......	51
Tow	33	8	8	29	20	......	9	......	107
									270
West:									
Steam	5	1	18	11	41	......	11	11	98
Sail	11	2	22	6	23	......	3	7	74
Tow	2	......	14	2	45	......	28	16	107
									279

TABLE No. 1.—*Tabular record of vessels taking refuge in the harbor of refuge, Sand Beach, Lake Huron, &c.*—Continued.

Direction of wind at time of entering.	1884.						1885.		Total.
	July.	August.	September.	October.	November.	December.	May.	June.	
Southwest:									
Steam	3	2	6	22	3	6	4	3	49
Sail	3	3	12	25	4	1	3	2	53
Tow	......	1	2	31	2	2	7	2	47
									149
South:									
Steam	......	4	4	11	3	1	8	9	40
Sail	2	3	......	13	1	......	4	4	27
Tow	......	......	2	10	......	2	2	2	18
									85
Southeast:									
Steam	1	1	6	3	6	......	5	......	23
Sail	1	4	1	2	2	......	1	......	11
Tow	......	......	2	......	2	......	......	......	4
									37
East:									
Steam	......	......	2	......	4	......	3	......	9
Sail	......	......	......	......	1	......	......	......	1
Tow	......	......	......	......	......	......	......	......	......
									10
Northeast:									
Steam	8	6	9	8	3	8	......	1	38
Sail	2	8	5	1	......	......	2	4	22
Tow	7	1	10	9	2	......	......	......	29
									89
Monthly totals:									
Steam	57	35	72	87	82	11	48	43	435
Sail	46	46	52	54	40	1	23	22	284
Tow	46	19	44	92	71	4	50	37	372
Totals	149	100	168	233	193	16	130	102	1,091

TABLE No. 2.—*Classified table of tonnages, by months, entering the harbor of refuge, Sand Beach, Lake Huron, from June* 30, 1884, *to June* 30, 1885.

Month.	Steam.	Tonnage.	Sail.	Tonnage.	Tow.	Tonnage.	Total vessels.	Total Tonnage.
1884.								
July	57	17,243.63	46	6,161.12	46	18,371.00	149	41,775.75
August	35	8,224.59	46	5,042.89	19	7,631.64	100	20,899.12
September	72	20,358.49	52	4,144.28	44	13,568.43	168	38,071.25
October	87	34,170.40	54	5,936.35	92	31,568.60	233	71,675.44
November	82	35,767.38	40	6,850.67	71	23,128.01	193	65,246.06
December	11	1,920.69	1	262.66	4	1,364.31	16	3,547.66
1885.								
May	48	12,949.54	23	2,116.59	50	19,624.24	130	34,690.37
June	43	12,846.09	22	2,093.20	37	11,453.87	102	26,393.16
Total	435	143,480 91	284	32,107.76	372	156,710.07	1,091	302,298.76

TABLE No. 3.—*Tonnage of vessels taking shelter in the harbor of refuge, Sand Beach, Lake Huron.*

Calendar year.	Steam.	Sail.	Towed.	Total tonnage.	Total number of vessels.	Average tonnage.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Number.*	*Tons.*
1877	63, 966	27, 699	50, 954	142, 619	498	286
1878	104, 025	39, 699	99, 282	248, 006	781	311
1879	133, 080	45, 750	100, 096	278, 926	921	303
1880	158, 702	55, 630	147, 260	361, 592	1, 317	275
1881	144, 645	55, 960	127, 855	328, 460	1, 176	279
1882	146, 132	26, 504	114, 067	286, 703	1, 022	280
1883	177, 122	32, 718	114, 091	328, 926	1, 139	284
1884	156, 518	34, 724	122, 980	314, 222	1, 142	275
Total	1, 084, 190	318, 679	876, 585	2, 279, 454	7, 991	285

Abstract of bids for furnishing timber and plank for crib work at the harbor of refuge at Sand Beach, Mich., received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 25, 1884, *in accordance with advertisement dated August* 6, 1884.

No.	Names and residences of bidders.	White-pine timber and plank per 1,000 feet, B. M.	Remarks.
1	Brooks, Joslyn & Co., Port Huron, Mich	$16 50	Recommended for acceptance.
2	Henry Howard & Co., Port Huron, Mich	Lot 1 24 00 Lot 2 22 00 Lot 3 20 00	Can only furnish one lot; informal.

Abstract of bids for furnishing one dredge, one tug, and two dump-scows, for removing shoals in and around the harbor of refuge at Sand Beach, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 25, 1884, *in accordance with advertisement dated August* 6, 1884.

No.	Names and residences of bidders.	Price per hour.
1	*George Talbot, Buffalo, N. Y	$7 90
2	Louis P. and James A. Smith, Cleveland, Ohio	8 40
3	John Hickler, Buffalo, N. Y	8 49
4	James Rooney, Toledo, Ohio	10 00
5	I. P. Clark, Springwells, Mich	18 00
6	Chicago Dredging and Dock Company, Chicago, Ill	18 50

* Recommended for acceptance.

Abstract of bids for furnishing a tug for use at the harbor of refuge at Sand Beach, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 25, 1884, *in accordance with advertisement dated August* 6, 1884.

No.	Names and residences of bidders.	Name of tug.	Price per month.
1	*Calvin Currie, Algonac, Mich	George Hand	$390
2	Henry G. Blanchard, Detroit, Mich	William Park	450
3	John W. Averill, jr., & Co., Cleveland, Ohio	Helene	567
4	Louis P. and James A. Smith, Cleveland, Ohio	Fannie Tuthill	1, 040

* Recommended for acceptance.

REFUGE

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Abstract of bids for furnishing iron bolts, plates, and spikes for crib-work at the harbor of refuge at Sand Beach, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 25, 1884, *in accordance with advertisement dated August* 6, 1884.

No.	Names and residences of bidders.	Price per pound of iron plates, 43,200 pounds.	Price per pound of blunt bolts, 42,500 pounds.	Price per pound of pointed bolts, 14,580 pounds.	Price per pound of boat spikes, 11,200 pounds.	Price per pound of ladder irons, 820 pounds.	Total.
		Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	
1[1]	W. H. McCurdy & Co., Cleveland, Ohio	2.6	1.95	2.05	2.4	2.5	$2,536 64
2	Condit, Fuller & Co., Cleveland, Ohio	2.6	1.9	2.15	2.45	4.25	2,555 68
3[2]	Michigan Bolt and Nut Works, Detroit, Mich	2.6	2.125	2.125	2.4	2.125	2,622 57
4	Ducharme, Fletcher & Co., Detroit, Mich	2.6	2.15	[3]2.15 [4]2.20 [5]2.50	2.4	2.20	2,645 86
5	Wallace M. Patterson, Cleveland, Ohio	2.8	2	2.2	2.45	2.25	2,673 48
6[2]	Frank Wilson, Cleveland, Ohio	2.75	2.1	2.25	2.4	2.25	2,696 02
7[2]	Ajax Forge Company, Chicago, Ill	3.25	2.58	2.63	2.7	2.63	3,186 93

[1] Recommended for acceptance. No price given for ladder irons; figured and included by me at price of pointed bolts.

[2] No price given for ladder irons, figured and included by me at price of pointed bolts.

[3] One-inch bolt.

[4] Three-quarter-inch bolt.

[5] One-half-inch bolt.

Abstract of bids for furnishing paints, oils, &c., for use at improving harbor of refuge, Sand Beach, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, April 15, 1885, *in accordance with paragraph* 1488, *United States Army Regulations.*

No.	Names and residences of bidders.	Total.
1	*J. P. Donaldson & Co., Detroit, Mich	$154 22
2	H. D. Edwards, & Co., Detroit, Mich	175 51
3	J. Jenks & Co., Sand Beach, Mich	190 00

*Accepted.

L L 10.

IMPROVEMENT OF ICE-HARBOR OF REFUGE AT BELLE RIVER, MICHIGAN.

The project for this improvement was adopted in 1880, the object being to make a channel 50 feet wide, 13 feet deep to the first bridge, and 12 feet deep thence to the second bridge, affording a safe harbor against running ice.

At the date of the last annual report the project had been completed, except one cut for about half the distance between the first and second bridges, and such other works as might be found necessary upon resuming operations.

The original estimate for the work was $14,465, and of this amount the sum of $12,000 had been appropriated and expended up to the close of the fiscal year ending June 30, 1883, when it was estimated that a further appropriation of $2,000 would suffice to complete the project.

This amount was appropriated by the act of Congress approved July 5, 1884.

On March 7, 1885, proposals were invited for the remaining portion of the excavation, to be opened March 23. Only two bids were received, a certified schedule of which is given below.

The bid of Thomas M. Hubbell to do the work as specified at the rate of 20 cents per cubic yard, scow measurement, being the lower, was accepted, and articles of agreement, dated March 31, 1885, were entered into accordingly.

The season having sufficiently advanced, work was begun on May 4, 1885, commencing at the end of the west cut of 1882, about 300 feet below the lower swing-bridge. A cut was carried up through the west opening of the bridge to a connection with the finished cut. It was found that the depth of 12 feet could not be attained through the west bridge opening without endangering the stability of the bridge, and it was consequently reduced to 10 feet. This portion of the channel was obstructed by a number of piles and sunken logs, which were removed and deposited on the bank.

Upon completion of the work at the lower bridge the dredge was placed at the end of the west cut of 1883, about 800 feet below the upper bridge, and a cut carried up to the cable of the Western Union Telegraph Company, which crosses the river about 150 feet below the upper bridge. Whilst dredging this cut it was found that the cut of 1883 was silted up to such an extent that in some places it was impossible to determine its boundaries, and at one point the depth of water had been reduced to 10½ feet.

Upon the completion of the west cut the dredge was placed at the lower end of the east cut of 1883, and a cut carried through the east opening of the upper bridge. The dredge was then moved back and the deposit, referred to above, was dredged out for a distance of about 300 feet, thus restoring the channel.

Work was then resumed on the cut above the upper bridge, and it was extended to a point about 400 feet above the bridge.

The work proposed was completed on June 4, when operations were discontinued, a total of 8,109 cubic yards of material having been removed.

A chart* is transmitted herewith, showing the location of the several dredged areas and the present condition of the improvement.

The following is a summary of the work done:

Items.	Cubic yards.	Length.
		Feet.
At lower bridge (18 piles drawn)	2,167	375
West cut to upper bridge	2,308	665
East cut through bridge	3,084	656
East cut redredging	500	330
Piles and timber not estimated in scows	50	....
Total	8,109	2,026

The result of the season's operations is the completion of the original project, with the addition of a 10-foot channel through the west draw of the lower bridge, and the extension of the 12-foot channel by a single cut for a distance of 440 feet above the upper bridge, and the cost has been $465 less than the original estimate.

---

*Omitted.

This improvement is now in excellent condition, and will probably require no further attention for two or three years; even in its incomplete condition fifty-one vessels were sheltered by it last winter.

Nothing further being required at this time, no estimate is submitted.

Belle River is in the collection district of Huron, Mich., the nearest port of entry being Port Huron, and the nearest light-house at Saint Clair Flats Canal.

Money statement.

Amount appropriated by act approved July 5, 1884	$2,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,952 90
July 1, 1885, amount available	47 10

Abstract of bids for improving ice-harbor at Belle River, Michigan, received and opened by Lieut.-Col. O. M. Poe, Corps of Engineers, on March 23, 1885, in accordance with advertisement dated March 7, 1885.

No.	Names and residences of bidders.	Dredging price per cubic yard, scow-measure.
		Cents.
*1	Thomas M. Hubbell, Saginaw, Mich	20
2	Carkin, Stickney & Cram, East Saginaw, Mich	25

* Recommended for acceptance.

L L II.

GENERAL REPAIRS AND RENEWALS AT SAINT CLAIR FLATS SHIP-CANAL.

The necessity of these has now become so pressing that, at the risk of tedious repetition, I quote from previous reports:

> The necessity for repairs to this work is constantly recurring, arising from the manner of its construction and the materials used. The original plans were made for a channel depth of 13 feet and width of 300 feet, which was considered ample at that time.
>
> Subsequently (in 1873) it was found necessary to increase the available depth in the channel, which was done by excavating for 100 feet on each side of the axis of the canal to a depth of 16 feet, leaving the bottom on either side of this deepened channel to take such slope as it would assume.
>
> It was thought that this berme on each side, of nearly 50 feet in width, with a height of 3 feet (slope about 1 to 16), would be ample to support the lower ends of the sheet-piling; and, but for the occasional action of propeller-wheels when violently turned near to or in contact with the sides of the canal, it would do so.
>
> Some of the caving of the sides referred to in former reports has undoubtedly arisen from the undermining of the sheet-piling from this cause.
>
> But I am of opinion that much of the greater portion of the difficulty has been due to the fact that the sheet-piling is a single course, and, not joining closely, the fine sand of the bank finds its way through the interstices.
>
> Two projects are submitted for the radical cure of this defect—the first by Major Harwood, United States Engineers, under date of February 24, 1882; the second, by Major Farquhar, on January 9, 1883. Each of these officers also included projects for the repair of the superstructure, and the latter one for replacing the superstructure of the revetment on the lake side of the piers.
>
> Of these two plans I prefer the one submitted by Major Farquhar, and append a copy of his report, which I recommend for adoption. He gives an estimate in detail, which in the aggregate amounts to $132,908. (Page 1877 *et seq.*, Annual Report Chief of Engineers, 1883.)

Since that estimate was made for a channel depth of 16 feet, it has become manifest that the commerce of the lakes will at no distant day demand a depth of 20 feet, and any remedial measures now adopted at this work should be based upon that fact. To provide for the additional depth of sheet-piling required for such a channel, being an increased depth of 4 feet, or 25 per cent., will render necessary the addition of 25 per cent. to the estimate of the cost of the under-water revetment, as given by Major Farquhar in the report referred to.

This addition will amount to $20,381, and increase the total estimate to $153,289, which should all be appropriated in one sum, in order that one contract could be made to cover the entire work.

The condition of affairs, as given at page 2071 of the Annual Report of the Chief of Engineers for 1884, has grown worse, and the structures plainly show the effect of one more year's wear and tear.. Even if appropriation be made at the coming session of Congress, it will probably be so late in the season that the remainder of it will be consumed in making the contracts.

The timber can then be gotten out during the following winter, thus bringing us to the opening of the season of 1887 before anything of importance can actually be done at the canal.

Meanwhile the processes of decay will have gone on for nearly two more years, and the condition of the old timber structures can be more readily imagined than described.

The great importance of this improvement is so well known; its use by nearly 40,000 vessels per year, carrying nearly 20,000,000 tons, hailing from every lake port both in the United States and Canada, is so advantageous, that no additional representation seems necessary to properly present its claim, to early and favorable consideration.

Saint Clair Flats Canal is in the collection district of Detroit, Mich. Two light-houses stand upon its banks.

Money statement.

Amount (estimated) required for proposed project	$153,298
Amount that can be profitably expended in fiscal year ending June 30, 1887..	153,298

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

L L 12.

SAINT CLAIR FLATS SHIP-CANAL.

The canal was projected in 1866, with a view to obtaining a straight channel 13 feet deep and 300 feet wide across Saint Clair Flats, and completed accordingly.

This project was modified in 1873 so as to obtain a channel of 16 feet in depth and 200 feet wide, lying half on each side of the axis of the canal. On either side of the canal is a dike of nearly 7,300 feet in length, an aggregate of nearly 14,600 feet, or more than 2¾ miles.

These dikes consist of timber cribs resting upon piles driven into the original bottom of the shoal and filled with material dredged from the channel. To maintain a channel bank, a single row of sheet-piling was driven along the channel face of the cribs previous to dredging.

The lake sides of the dikes were protected from wave action by horter sheet piling.

The entire timber superstructure is now much decayed and ought to e renewed.

The single row of sheet-piling proves to be insufficient to prevent the eakage of material into the channel of increased depth, and requires o be reinforced.

As it now stands, intended for a 13-foot channel, and made to do uty for one of 16 feet, it is manifest that no greater depth can be aintained without this reinforcement by sheet-piling of at least 8 feet reater penetration.

The estimated cost of these repairs and renewals is $153,298.

OPERATING AND CARE OF THE CANAL.

The minor repairs involved in operating and care of the canal have been less than usual during the fiscal year. This was largely due to the fact that the stage of water was better, and, in consequence, fewer vessels grounded in the canal, and less damage was done to the dikes. Cavities were filled with cedar bark; the willows were trimmed and the uttings, tied in bundles, also deposited in cavities; plank placed on the lake side of the dikes where they were most threatened with injury from the wash of waves, and some other trifling matters attended to, all at a cost of $334.60.

About the close of the fiscal year 1883–'84, it became apparent that extensive repairs must be made at the lower end of the east dike, and under proper authority this was undertaken.

A contract dated July 3, 1884, was entered into with Messrs. Candler Brothers for the specified materials and labor.

The contractors promptly commenced and carried the work to satisfactory completion for the sum of $2,531.33, which was paid from the indefinite appropriation for operating and care of Saint Clair Flats Canal. The incidental expenses attending this portion of the work amounted to $37.64, of which $27.67 was reported in the previous fiscal year.

In January, 1885, a survey was made in connection with the examination and survey of Saint Clair River, provided for by the river and harbor act of July 5, 1884, from the results of which it was ascertained (see L L 21) that, whilst the depth of 16 feet was well maintained throughout the canal, the channel at the ends had silted up to such an extent as to require extensive dredging to re-establish it.

A project for doing this was submitted on the 31st March, at an estimated cost of $13,200, to be defrayed from the indefinite appropriation made by section 4 of the river and harbor act of July 5, 1884.

This was duly approved May 5. As soon as the requisite preliminaries could be gone through with, proposals for the work were opened on the 8th June, and the contract awarded to Edwin H. French, at the rate of 11½ cents per cubic yard, scow-measurement—a remarkably low price.

Articles of agreement were signed June 11. The contractor was on the ground with one dredge on the 25th, and additional dredges are promised.

The extremely low price at which this work is to be done will admit of the removal of twice the amount of material estimated, thus greatly improving the channels of approach and rendering the navigation easier than ever before.

The total amount expended during the fiscal year on account of
ating and care of the canal was—

For salary of custodian	$1,
Materials, labor, printing, &c., including outstanding liabilities	3,
Total	4,

The details of which, as required by law, are given in the
panying itemized statement.

The estimated cost of operating and care for the fiscal year
June 30, 1885, was—

Salary of custodian	$1
Current repairs, which can neither be foreseen nor estimated for in detail.	10
Total	11

The estimated cost of operating and care for the fiscal year
June 30, 1886, is as follows:

Salary of custodian	$
Dredging approaching to canal, now under contract	1
Current repairs, which can neither be foreseen nor estimated for in detail.	
Total	1

All of which is provided for by indefinite appropriation.

Abstract of bids for repairs at and near lower end of the east dike of Saint Clair
nal, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Enginee
1, 1884, in accordance with advertisement dated June 17, 1884.

Materials.	Candler Brothers, Detroit, Mich.*
2,300 feet B. M., more or less, common pine plank, 2 by 12 inches and not over 20 feet long, per M feet B. M. in place	$20 0
30, more or less, white-oak round piles, 30 feet long, per pile in place	4 5
1,[illegible] feet B. M., more or less, white-oak stringers, 4 by [illegible] inches by 20 feet, per M feet B. M. in place	30 0
1,300 feet B. M., more or less, white-oak stringers, 6 by 8 inches by 20 feet, per M feet B. M. in place	30 0
300, more or less, white-oak sheet-piles, 4 by 12 inches by 18 feet (21,600 feet B. M.), per M feet B. M. in place	32 0
200 cords, more or less, brush, per cord in place	3 5
[illegible] cords, more or less, [illegible], per cord in place	2 0
[illegible] cords, more or less, [illegible], per cord in place	7 0
[illegible] pounds, more or less, spikes, [illegible] inches, wrought, per pound in place	0
500 pounds, more or less, spikes, [illegible] inches, wrought, per pound in place	0
[illegible] pounds, more or less, bolts, [illegible] inches, per pound in place	0
Approximate total	2,452

* Complete September 1, 1884; recommended for acceptance. † Complete Septem

NOTE.—One bid was received at 2.30 p. m., too late for consideration, and therefore n

Abstract of bids for dredging at Saint Clair Flats Canal, Michigan, received and op June 8, 1885, *in accordance with advertisement dated May* 18, 1885.

No.	Names and residences of bidders.	Dredging price per cubic yard, scow measure.
		Cents.
*1	Edwin H. French, Toledo, Ohio	11⅛
2	James Rooney, Toledo, Ohio	12⅜
3	Carkin, Stickney & Cram, East Saginaw, Mich	12.9
4	Skeldon, Buck & Co., Toledo, Ohio	13
5	Louis P. and James A. Smith, Cleveland, Ohio	13
6	Charles S. Barker, Sault Sainte Marie, Mich	13
7	William Richardson, Buffalo, N. Y	16
8	Stang & Gillmore, Lorain, Ohio	17⅞
9	Chicago Dredging and Dock Company, Chicago, Ill	21
10	Thomas M. Hubbell, Saginaw, Mich	22

* Recommended for acceptance.

Itemized statement of expenditures incurred on account of appropriation for operating an care of Saint Clair Flats Canal, Michigan, during the fiscal year ending June 30, 1885.

MONTH OF JULY.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1884.				
June 16	1	The Detroit Free Press	Advertising proposals for material, &c	$4 10
17	2	Post and Tribune Company, Detroit, Mich.	......do	3 00
17	3	The Times Company, Port Huron, Mich.	......do	1 25
26	4	C. J. Dowswell & Co	2,000 B. M., pine lumber, $14.50 M	29 00
July 31	5	Pay-roll, July 1884	1 custodian, 1 month, $125 per month	125 00
			1 laborer, 15 days, $50 per month	25 00

MONTH OF AUGUST.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
July 29	1	Western Union Telegraph Company	Transmitting telegrams	1 62
Aug. 9	2	D. W. Watson	50 cords cedar bark, $1.25 per cord	62 50
21	3	O. M. Poe, lieutenant colonel of Engineers, &c.	Mileage, Detroit to Saint Clair Flats Canal and return.	3 68
29	4	Candler Brothers, under contract dated July 3, 1884.	3,096 feet B. M. pine plank, $20 M	61 92
			50 round white-oak piles, $4.50 each	225 00
			2,864 feet B. M. white-oak stringers, $30 M.	85 92
			22,320 feet B. M. white-oak sheet piles, $32 M.	714 24
			195½ cords brush, $3.50 per cord	684 25
			156 cords cedar bark, $2 per cord	312 00
			51½ cords stone, $7	360 50
			1,350 pounds spikes, 5 cents per pound	67 50
			Extra labor straightening piles	10 00

MONTH OF SEPTEMBER.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
Sept. 1	1	Pay-roll, August	1 custodian, 1 month, $125 per month	125 00
			1 laborer, 1 month, $50 per month	50 00
17	2	C. J. Dowswell & Co	1 keg white lead	88
			5 cans paint, at 22 cents each	1 10
			1 gallon paint oil	70
30	3	Pay-roll, September	1 custodian, 1 month, $125 per month	125 00
			1 laborer, 6 days, $2 per day	12 00

Itemized statement of expenditures incurred on account of appropriation for operating and care of Saint Clair Flats Canal, Michigan, &c.—Continued.

MONTH OF OCTOBER.

Date.	No. of voucher.	From whom purchased.	Articles.	Total.
1884. Oct. 31	1	Pay roll, October	1 custodian, 1 month, $125 per month	$125 00
			1 laborer, 3 days, $2 per day	6 00

MONTH OF DECEMBER.

Dec. 1	1	Pay-roll, November	1 custodian, 1 month, $125 per month	125 00
30	2	W. H. Mott	Services, December, (part)	120 00
30		Deposited to the credit of the Treasurer of the United States to balance account.		60
31	1	W. H. Mott	Services as custodian for December (part), $125 per month.	5 00

MONTH OF JANUARY.

1885. Jan. 31	1	W. H. Mott	Services as custodian, January 1885	125 00

MONTH OF FEBRUARY.

Feb. 28	1	W. H. Mott	Services as custodian, February 1885	125 00

MONTH OF MARCH.

Mar. 31	1	W. H. Mott	Services as custodian, March 1885	125 00

MONTH OF APRIL.

Apr. 30	1	W. H. Mott	Services as custodian, April, 1885	125 00

MONTH OF MAY.

May 14	1	Pay-roll, May	7 laborers, 67 days, at $1.75 per day	117 25
			1 laborer, 11½ days, at $1.50 per day	17 25
13	2	John A. Smith	Hire of 1 scow 3 days, $3 per day	9 00
5	3	J. P. Donaldson & Co	15 pounds lath yarn, 8 cents per pound	1 20

MONTH OF JUNE.

May 31	1	W. H. Mott	Services as custodian, May, 1885	125 00
19	2	William H. Thompson, manager	Furnishing paper, printing and binding 300 copies of specifications, &c., for dredging.	24 00
Mar. 28	3	J. P. Donaldson & Co	25 pounds lath yarn, at 10 cents per pound.	2 50
			Freight on same, Detroit to Saint Clair Flats.	25
			Putting up five awnings at windows of office superintending engineer, Detroit, at 20 cents each.	1 00
June 18	4	Harry F. Hodges, first lieutenant Engineers.	Mileage from Detroit to Saint Clair Flats Canal and return, 46 miles.	3 68
		Total		807 00

RECAPITULATION.

Expended on account of appropriation for operation and care of Saint Clair Flats Canal, Michigan	$3,467 85
Expended on account of appropriation for operation and care of canals, &c., applied to Saint Clair Flats Canal	807 00
	4,274 85
Expended as above	4,274 85
Outstanding liabilities	632 43
Total expenditures	4,907 28

L L 13.

IMPROVEMENT OF CLINTON RIVER, MICHIGAN.

In 1870 the channel over the bar at the entrance to this river afforded a depth of only 3½ feet, whilst the depth in the river some distance above the bar was 10 feet.

The present project for the improvement was adopted in 1870 and modified in 1880. It aims to obtain an entrance channel of 60 feet in width and 8 feet in depth.

This was practically accomplished in 1882.

The river and harbor act of July 5, 1884, provided for a preliminary examination of Clinton River.

A report was submitted November 13, 1884, in which a survey was recommended.

The recommendation was approved by the Chief of Engineers, and the survey was made between the 5th and 20th January, 1885.

A full report was submitted January 23. Herewith is transmitted a copy of both the reports referred to above. I have nothing new to add to the information and recommendations of the report of January 23.

No complaints of the condition of the channel have reached me; but it must be remembered that the stage of water is, and has been all along, some 18 inches higher than our zero.

Estimated cost of the project now proposed, $32,926.

The work is situated in the collection district of Detroit, Mich., which is the nearest port of entry. The nearest light-house is the beacon on Saint Clair Flats.

Money statement.

Amount (estimated) required for completion of existing project	$32,926 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	32,926 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

L L 14.

IMPROVEMENT OF DETROIT RIVER, MICHIGAN.

Originally the channel at Lime Kilns Crossing, Detroit River, could be depended upon for only 13 feet of water, the ordinary depths being much affected by winds.

As originally projected in 1874 the improvement at this point was to consist of a curved channel 300 feet wide, with a uniform depth of 20 feet, and the estimate was based upon this project.

It was subsequently (in 1883) determined to modify the project so as to secure a straight channel, the least width of which should be 300 feet, with a somewhat greater width at each end, utilizing the work already done. This constitutes the project as now under execution, and if the present rate of progress is maintained, it will be completed by the 30th June, 1886.

Owing to the exhaustion of previous appropriations all operations had ceased on the 16th August, 1883. By the act of July 5, 1884, the sum of $200,000 was appropriated for continuing the work, and on the 29th August, 1884, a contract was made with Messrs. Carkin, Stickney & Cram for continuing the work, at the low price of $5.40 per cubic yard for rock excavation.

After more than a year's suspension operations were resumed on October 1, 1884, and have been prosecuted steadily since, being interrupted only by weather and accidents, with the following satisfactory results:

Area drilled and blasted	square feet..	90, 538
Area dredged, but not cleaned	do....	82, 383
Solid rock removed	cubic yards..	8, 369
Loose rock removed	do....	32

Making the total amount of work done to June 30, 1885, as follows:

Area completed	square feet..	464, 120
Area drilled and blasted (1884–'85)	do....	90, 538
Area dredged but not cleaned	do....	82, 383
Solid rock removed, scow measurement, (not included in following item), cubic yards		2, 632
Solid rock removed, pit measurement	cubic yards..	47, 627
Loose rock removed	do....	849

And the quantity of solid rock remaining to be removed to complete the present project is estimated at 19,232 cubic yards, pit measurement.

It is expected that a second dredge will be put at work before the middle of August, exclusively at cleaning up the area already passed over by the first dredge, and, if nothing untoward occurs, that the improved channel will be available to some extent upon the opening of navigation next spring.

The appended report of Mr. H. Kallman, assistant engineer, details the progress of the operations, and, together with the accompanying tracings, shows the present condition of the improvement, the work remaining to be done to complete the present project, and the additional work proposed in this report.

The statistics with Mr. Kallman's report show that 46,939 vessels, having an aggregate tonnage of 19,645,271, passed the Lime Kilns Crossing during the season of 1884. Of these, 5,226, having a tonnage of 1,050,964, were Canadian vessels. They also show that this commerce is more than six times as great as the railroad tonnage crossing Detroit River during the same time.

Being greatly impressed by the magnitude of the interests concerned in this improvement, and by the fact that the present project will be completed at a cost of *less than half that originally estimated*, I have taken into consideration the question of increasing the width of the channel to 400 feet. The argument in favor of this proposition is a very simple one and is thus stated.

The channel is made by blasting the ledge of rock constituting the obstruction, and afterwards removing the débris by dredging. The edges of the channel are consequently left as ragged as saw-teeth, and should a vessel come in contact with them she would surely come to grief. Ordinarily the width of 300 feet should be sufficient for safe navigation, notwithstanding the jagged character of these edges, but at this point the current has a velocity of as much as 2½ miles per hour; much of the shipping is by tows, some of which are a half a mile in length; they *must* move rapidly enough to keep steerage-way, and if three such tows should find themselves in the cut at one time, a not unusual occurrence, it would be almost a miracle if all escaped injury. Whilst the increased width would not provide against similar edges to the channel, the chances of striking them would be so greatly diminished as to render the navigation, with due care, measurably safe.

In view of the foregoing, I venture to submit the following estimate for widening the cut an additional 50 feet on each side:

The additional rock excavation which would be required is—

	Cubic yards.
On the east side	10,370
On the west side	13,628
Total	23,998

If the amount necessary to do this additional work be appropriated in one sum, I estimate that it would cost at the rate of $7 per cubic yard, or an aggregate of $167,986.

It is true that we are now getting the rock removed for $5.40 per cubic yard, but the additional work could probably not be done at the same rate, because the cutting would be narrower, and on the east side the "face" would be less.

Even with this additional work the ultimate cost of the improvement will be only a little more than half the original estimate for the 300-foot curved channel.

The improvement benefits no local interests. On the contrary it is national in its character; the States of New York, Pennsylvania, Ohio, Illinois, Wisconsin, Iowa (northern part), and Minnesota, and even the Territories of Dakota and Montana, being more directly benefited by it than is the State of Michigan, upon the borders of which it is situated.

The appended tables show that the Dominion of Canada is so much interested as to give the improvement an international character.

The original estimate of the probable cost of the work was		$1,166,500
Estimated addition on account of the modification of 1883		40,000
Estimated cost of the additional width of 100 feet now proposed		167,986
Total estimate		1,374,486
Amount heretofore appropriated	$535,000	
Amount of estimate for completion with increased width of 100 feet	167,986	
		702,986
Actual cost less than estimate		671,500

Being convinced that no better application of that amount of money could be made, I earnestly commend the proposition to the proper authorities, and, so far as it is becoming in me to do so, urge the appropriation of the entire sum of $167,986 at one time, so that the whole work may be included in one contract.

At the same time, I beg leave to invite attention to the fact that the project now in progress will be completed with the funds at present available.

The work is located in the collection district of Detroit, Mich. The nearest port of entry is Detroit; the nearest light-house, the one under construction at the mouth of Detroit River; the nearest fort is Fort Wayne.

Money statement.

July 1, 1884, amount available		$113 79
Received from sale of fuel		39 39
Amount appropriated by act approved July 5, 1884		200,000 00
		200,153 18
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$37,005 85	
July 1, 1885, outstanding liabilities	13,761 87	
		50,767 72
July 1, 1885, amount available		149,385 46
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		167,986 00

Abstract of bids for improving Detroit River, Michigan, received and opened by Lieut. Col. O. M. Poe, Corps of Engineers, on August 25, 1884, *in accordance with advertisement dated August* 6, 1884.

No.	Names and residences of bidders.	Solid rock, price per cubic yard in place.	Loose rock, price per cubic yard in scow.	Remarks.
1	Carkin, Stickney & Cram, East Saginaw, Mich.	$5 40	$1 00	Recommended for acceptance.
2	Charles F. Dunbar, Buffalo, N. Y.	6 60	25	
3	Charles E. Williams, Buffalo, N. Y.	6 49	5 00	
4	John Hickler, Buffalo, N. Y.	7 00	4 50	
5	Edwin H. French, Fulton, N. Y.	7 75	7 75	
6	Chicago Dredging & Dock Company, Chicago, Ill	8 50	8 50	
7	Fitzsimons & Connell, Chicago, Ill.	8 70	8 70	
8	George W. Townsend, Boston, Mass.	9 40	7 00	Informal, no guarantee, &c.

REPORT OF MR. H. KALLMAN, ASSISTANT ENGINEER.

GROSSE ISLE, MICH., *July* 1, 1885.

GENERAL: I have the honor to submit the following report upon the progress of the work of the improvement of the Detroit River at Lime Kiln Crossing during the fiscal year ending June 30, 1885:

Operations at this work were stopped August 16, 1883, for want of funds.

Under the appropriation of $200,000 made by act approved July 5, 1884, a contract was entered into with Messrs. Carkin, Stickney & Cram, August 29, 1884.

Drilling and blasting commenced October 1, and continued day and night until December 16. The dredge worked steadily from October 20 to December 16, when operations were suspended for the season on account of the formation of ice in the river.

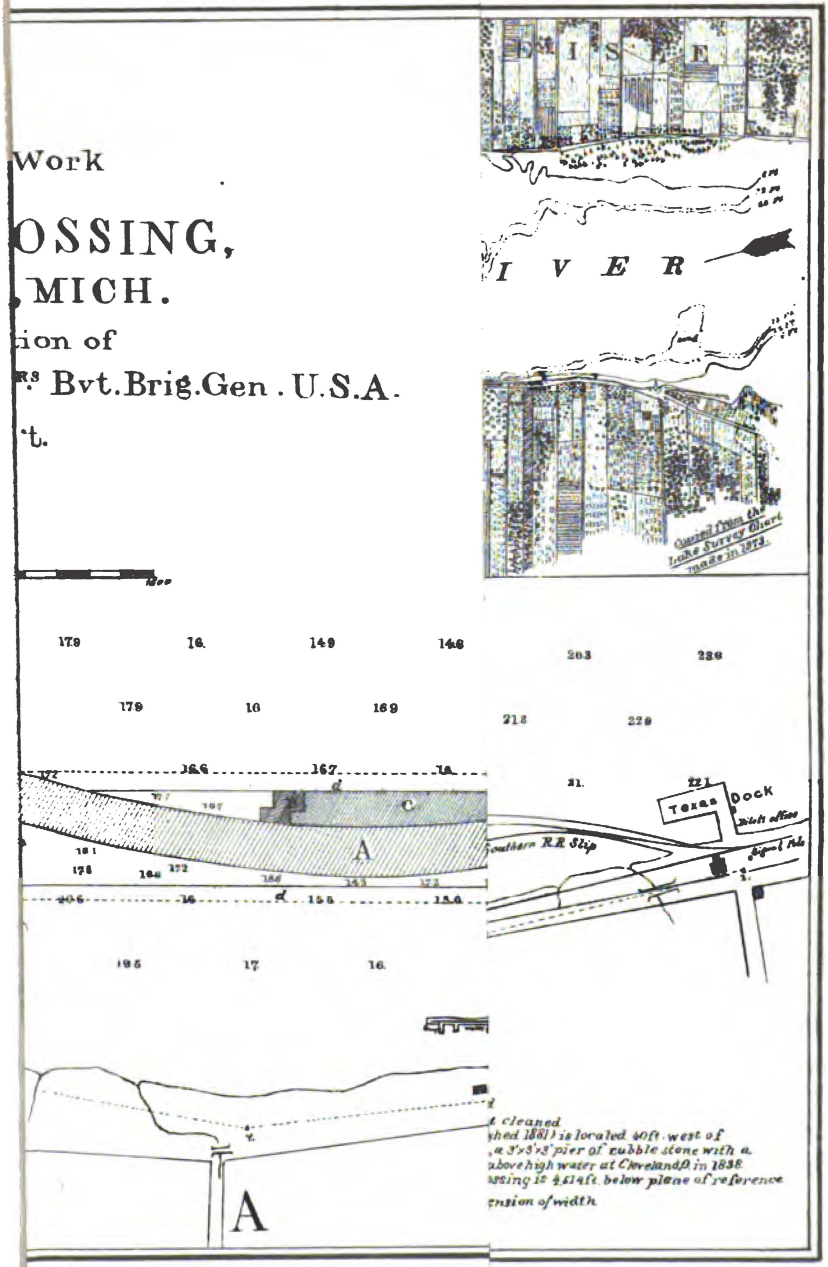
Work was resumed April 4, and has been carried on to date without interruption, with the exception of eight days lost by the drill, which sank May 1, upon being struck by a cartridge which had escaped from the drill-hole.

The amount of work done under the present contract is as follows:

Four thousand three hundred and thirty holes, averaging 6 feet 6 inches in depth, have been drilled and blasted, with an average of 6¼ pounds of first-class dynamite per charge, making a total of 27,145 linear feet and 27,145 pounds of dynamite.

Area drilled and blasted	square feet	90,538
Area dredged	do	82,383
Solid rock removed	cubic yards	8,369
Loose rock removed	do	32
Total amount of work done to date:		
Area completed	square feet	464,120
Area drilled and blasted	do	90,538
Area dredged (not cleaned)	do	82,383
Solid rock removed (scow measurement)	cubic yards	2,632
Solid rock removed (pit measurement)	do	47,627
Loose rock removed	do	849

There remains to be removed a quantity of 19,232 cubic yards of solid rock.



Work

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Rs Bvt.Brig.Gen. U.S.A.

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t cleaned
shed 1881) is located 40ft. west of
, a 3'x3'x3' pier of rubble stone with a
above high water at Cleveland,O. in 1838.
ossing is 4.614ft. below plane of reference
ension of width

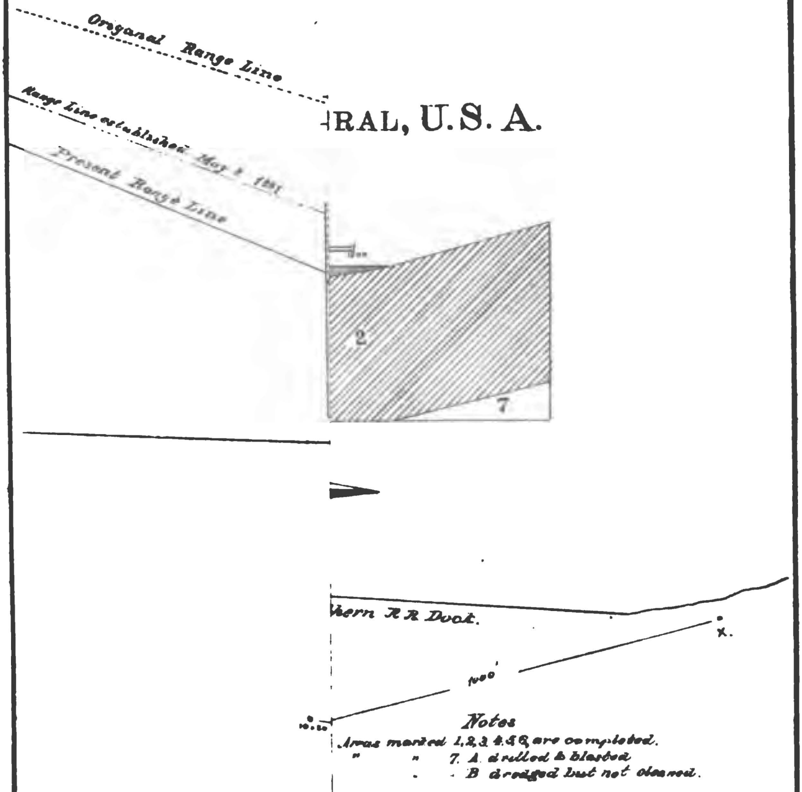
Copied from the Lake Survey Chart made in 1873.

SHEET No. 3.

Nº	Conꝁemarks.
1	OG *included in Contract 3.*
2	C.F *th 1880.*
3	*29th 1880*
4	*th 1881.*
5	*th 1882.*
6	*th 1882.*
7	Carkin, Sti *6869 yds Solid* *32 " loose* *are removed*

h my Annual Report for
ding June 30th 1885.

O. M. Poe
Lieut. Colonel of Engineers
Bvt. Brig Gen. U.S.A



RAL, U.S. A.

Notes
Areas marked 1,2,3,4,5,6, are completed.
" " 7. A. drilled & blasted
" " B dredged but not cleaned.

H Ex1 pt2 v2 49 1

A second dredge will commence work next month, and do the cleaning of the area blasted and dredged west of the cut, so as to allow vessels to pass through the cut by the reopening of navigation next season.

The accompanying tracing marked No. 1 shows the present condition of the work, Tracing No. 2* the water-gauge observations during the time the work has been in progress, and Tracing No. 3 the amount of work done under the different appropriations.

The following statistics show the importance of this improvement:

The loss by detention and damage by striking and sinking to vessels of only the four following steamboat companies, Union, Anchor, Commercial, and Western Transportation, during the season of 1880, 1881, and 1882, amounted to $410,000. All damage to vessels during the seasons of 1883 and 1884 does not amount to more than $75,000.

The official statements of the collectors of United States customs, at the lake ports show that the number of American vessels cleared from them, which passed through the Detroit River, was as follows:

Season.	Number of vessels.	Tonnage.
1880	40, 521	20, 235, 249
1881	85, 888	17, 572, 240
1882	35, 199	17, 872, 182
1883	40, 385	17, 695, 174
1884	38, 742	18, 045, 949

Number of vessels and tonnage cleared from Canadian ports which passed through the Detroit River during the season of 1884.

Nationality.	Number.	Registered tonnage.
Canadian vessels	3, 050	673, 126
United States vessels	2, 971	548, 358

Number of foreign vessels and tonnage cleared from United States ports which passed through the Detroit River during the season of 1884.

Number of vessels	2, 176
Tonnage	377, 838

Total number of vessels and tonnage which passed through the Detroit River during the season of 1884.

Nationality, &c.	Number.	Tonnage.
United States and Canadian vessels cleared from United States ports	40, 918	18, 423, 787
United States and Canadian vessels cleared from Canadian ports	6, 021	1, 221, 484
Total	46, 939	19, 645, 271

The following statement shows the number of loaded cars which crossed the Detroit River during the last four years:

Railroad.	1881.		1882.		1883.		1884.	
	East bound.	West bound.	East bound.	West bound.	East bound.	West bound.	East bound.	West bound.
Great Western	76, 065	62, 716	61, 636	61, 397	47, 069	39, 181	50, 558	34, 810
Canada Southern	92, 939	72, 897	69, 357	84, 889	102, 989	68, 028	96, 024	82, 236
Total	169, 004	135, 613	130, 993	146, 286	150, 058	107, 209	146, 582	117, 046
At an average of 12 tons per car	3, 655, 404 tons.		3, 327, 348 tons.		3, 087, 204 tons.		3, 163, 536 tons.	

---

* This tracing will be found with the report on water-level observations.

The following table shows the length of time navigation was open:

	Days.
April 3 to November 21, 1880	221
May 4 to December 17, 1881	226
April 5 to December 7, 1882	215
April 18 to November 18, 1883	213
April 12 to December 16, 1884	247
April 14, 1885, to	

Very respectfully, your obedient servant,

H. KALLMAN,
Assistant.

L L 15.

REPORT CONCERNING THE PORTAGE LAKE AND LAKE SUPERIOR SHIP-CANAL.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington D. C., December 22, 1884.

SIR: I have the honor to return herewith the resolution of the Senate of the United States of April 22, 1884, calling for detailed report concerning the Portage Lake and Lake Superior Ship-Canal, and the interest of the State of Michigan therein; also as to the rights, title, &c., of the Portage Lake and River Improvement Company (so called), with the view to securing said canal and improvement for the purpose of making same a free water-way for the use and benefit of navigation and commerce, which was referred to this office April 24, 1884.

I have the honor, in reply thereto, to submit the accompanying copy of the report thereon, dated the 6th instant, by Lieut. Col. O. M. Poe, Corps of Engineers, which, it is believed, will fully answer the inquiries contained in the resolution, and afford all necessary information in regard thereto. It will appear that the Portage Lake and River Improvement Company and the Lake Superior Ship-Canal, Railway, and Iron Company are willing to dispose of their property to the United States, free of all incumbrance of any kind, for the sum of $350,000, about one-tenth of the cost of the improvements, and that Colonel Poe is of opinion that "if the ownership of this important water-way, clear of all incumbrances, can be vested in the Government, thus rendering its navigation free to commerce, then there can be no question but that the price is reasonable, and the purchase is advisable."

It may be proper to add that this report has been delayed in consequence of the absence of the president of one of the companies from the country.

Very respectfully, your obedient servant,

JOHN G. PARKE,
Acting Chief of Engineers.

Hon. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., December 6, 1884.

SIR: I have the honor to submit the following report upon the subject matter of Senate resolution of inquiry of April 22, 1884, referred to me by indorsement dated Office of the Chief of Engineers, United States Army, April 25, 1884.

The resolution directs an inquiry to be made by the Secretary of War upon the following points, viz:

> (1) As to to the amount and value of all aids and grants of any kind from the United States to the State of Michigan, for the Portage Lake and Lake Superior Ship-Canal, or to any agent, trustee, or assignee of said State, of any such aids, whether person or corporation, up to the present time, computing the value of any and all lands donated therefor by the General Government at the rate of $1.25 per acre.
>
> (2) As to all other receipts, whether tolls, grants, privileges, or moneys received by the State of Michigan direct or through its agents, assignees, or as aforesaid, for and on account of construction, repair, or operating said canal up to the present time.
>
> (3) As to all proper costs and charges for expense of construction, repairs, or operating said canal up to the present time from or by the State or its said agents, trustees, assignees, &c., and shall report to the Senate the result of such inquiry, and shall also report, upon the best information obtainable, upon what terms and conditions it would be just and proper for the United States to procure and take possession of said canal for the purpose of making the same a free water-way for the use and benefit of navigation and commerce.
>
> (4) And also to inquire and ascertain upon what terms and conditions the Portage Lake and River Improvement Company will surrender and convey to the United States, for the purpose of making the same free to the general public for navigation and commerce, all their rights, title, and interest in and to the Portage River Improvement (so called) with each and all the appurtenances belonging thereto, including piers, canal-cuts, embankments, &c., as well as any and all rights of way to and through Portage Lake and said Portage River and the approaches thereto, and whether such terms are reasonable and proper to enable the United States to make said water-way free to the public, and such other information as may be obtained relating to the aforementioned subjects.

Preliminary to instituting the requisite inquiries, I put myself in communication with Mr. J. T. Whiting, of Detroit, who was understood to be especially interested in the matter, and at whose instance the resolution of inquiry was introduced in the Senate.

After consultation with him I addressed letters of inquiry to the secretary of the State of Michigan, to Theo. M. Davis, esq., president Lake Superior Ship-Canal, Railway, and Iron Company, and to Frederick Ayer, esq., president Portage Lake and River Improvement Company. The correspondence in the three cases is hereto attached, marked respectively A, B, and C, noting, however, that in the second case I have brought my questions and Mr. Davis's replies into juxtaposition, in order that they may more readily come under the eye at one and the same time.

I have also had access to the papers, documents, and land maps transmitted to me at the same time with the resolution of inquiry, including Mis. Doc. No. 50, House of Representatives, first session Forty-eighth Congress, and have been furnished by the Portage Lake and River Improvement Company with a map showing the work done by them.

The water communication across Keweenaw Point by way of the Portage River and Lake and the artificial cuts made to render it available, is under control of two companies: (1) The Portage Lake and River Improvement Company, from Keweenaw Bay to Portage Lake, and (2) The Lake Superior Ship-Canal, Railway, and Iron Company, from Portage Lake to Lake Superior. The former improvement was commenced by private individuals, who were subsequently incorporated under the act of the State of Michigan, providing for the formation of companies to construct canals or harbors, and improve the same, approved March 13, 1861. None of the original proprietors are now connected with the work, and the precise time when the work was commenced cannot now be stated. But it appears that the work had advanced sufficiently by June, 1862, to admit of its use for purposes of navigation. A statement of the work done up to that time, and subsequently, will be found in Appendix C.

The Lake Superior Ship-Canal, Railway, and Iron Company results from the Portage Lake and Lake Superior Ship-Canal Company, the articles of association of which were filed in the office of the secretary of state of Michigan, July 15, 1864. Amended articles were filed in the same office September 24, 1868, and an amendment, changing the name of the company to Lake Superior Ship-Canal, Railroad, and Iron Company was filed May 4, 1871. The canal was completed by the company and accepted by the governor of Michigan June 25, 1875.

The improvements of the company were afterwards sold under mortgage and the name changed to Lake Superior Ship-Canal, Railway, and Iron Company, the present owners. The deed of transfer is dated May 15, 1877, and it was filed in the office of the secretary of state of Michigan on the same day. The articles of association were again amended May 18, 1878, but the name remained unchanged.

The resolution of inquiry relates more particularly to the latter company, and I will therefore speak of it first.

(1) The amount of aids and grants from the United States to the State of Michigan, for the Portage Lake and Lake Superior Ship-Canal, was 400,000 acres of land (acts of March 3, 1865, and July 3, 1866.)

The amount actually certified to the State appears from the statement of the State land office to have been 398,720.52 acres. (Appendix A.)

The amount received by the canal company appears to have been 398,205.42 acres, the value of which, computed at $1.25 per acre, was $497,756.77. (Appendix B.) And it does not appear that any other aids or grants of any kind were made from the United States to the State of Michigan or to any individual or corporation for the benefit of this canal.

(2) Neither was any aid granted by the State of Michigan, nor were there any contributions in aid of the construction of the canal from private parties other than from the stockholders and creditors of the canal company. (Appendix B.)

The original canal company having failed, a receiver was appointed with authority to borrow money for the purpose of completing the canal and to secure the same by a first lien on all property of the company. Under this authority the receiver issued and sold certificates, secured as above, to the amount of $625,300, and actually received and expended $450,000. Neither the receiver nor assignee received any other contributions in aid of the construction of this canal. (Appendix B.)

The receipts from tolls for use of the canal, from 1874 down to and including the year 1883 (the latest returns), amounted in the aggregate to $75,053.13, and the expenditures from these funds for the same period to $70,146.79. (Appendix P, Mis. Doc. No. 50, House of Representatives, first session Forty-eighth Congress.)

Other than the grant of lands referred to in a preceding paragraph, the foregoing covers, so far as I have been able to ascertain them, all "receipts, whether tolls, grants, privileges, or moneys," from any and every source, for and on account of construction, repair, or operating said canal up to the beginning of 1884.

(3) The mortgage bonds issued to obtain money for the construction of the canal—

Amount (exclusive of interest) to	$3,300,000 00
There were issued and sold receivers' certificates to the amount of	625,300 00
And from 1874 to 1883, both inclusive, there was collected as tolls and expended upon the canal (principally in operating expenses) the sum of	70,146 79
Total	3,995,446 79
Of the above items we know that the tolls yielded	70,146 79
And the sale of receivers' certificates	450,000 00
Total	520,146 79

But are in entire ignorance as to the amount obtained from the hypothecation of the $3,300,000 mortgage bonds and expended on the canal. Still, from all the testimony, and especially that contained in Mis. Doc. No. 50, House of Representatives, first session Forty-eighth Congress, the probability is great that the aid supplied from all sources and applied to the construction and repair of the canal and in operating it, down to the beginning of 1884, amounted to fully $3,000,000.

(4) It will be seen from Appendix C that the two companies controlling this water-way are practically one, as the parties in interest are the same. It is proposed to convey to the United States a clear title to both canals, and all their rights, privileges, and appurtenances, for the sum of $350,000.

I have endeavored to ascertain whether, in case of purchase, this sum would cover the entire cost to the United States, and am assured that it would; that all indebtedness, by mortgage or otherwise, existing prior to May 15, 1877, on the property of the Portage Lake and Lake Superior Ship-Canal Company was canceled by the sale of that date and that none has accrued since; and that there is not now, and never was, any bonded debt or mortgage on the Portage Lake and River Improvement Company's property.

It has not been practicable for me to obtain a statement of the receipts and expenditures of this latter company on account of construction, maintenance, and operating, but I think it can be safely assumed that the construction account alone would amount to fully $300,000. If the above estimate of the minimum cost of the property of the Lake Superior Ship-Canal, Railway and Iron Company ($3,000,000), and that of the Portage Lake and River Improvement Company ($300,000), is warranted by the facts disclosed, then the price asked for the two ($350,000) may be stated as only one-tenth the original cost. And if, by the payment of that sum by the United States to the companies in question, the ownership of this important water-way, clear of all incumbrances, can be vested in the Government, thus rendering its navigation free to commerce, then there can be no question but that the price is reasonable and the purchase advisable.

In conclusion, I invite attention to the readiness with which the canal companies gave me such information as was in their power. Without this commendable action upon their part I would have been utterly unable to obtain any information of value for the purposes of this inquiry.

The delay in submitting this report has arisen from the fact that the president of one of the companies was absent from the country, so that it was not practicable to get from him replies to my interrogatories of July 10 in time to prepare it earlier. The papers referred to me are herewith returned.

I am, sir, very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

To the CHIEF OF ENGINEERS, U. S. A.

A.

LETTER OF LIEUTENANT-COLONEL O. M. POE.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., May 10, 1884.

SIR: Under instructions of the Chief of Engineers, U. S. A., I have the honor to request official information upon certain points called for by resolution of the Senate of the United States, dated April 22, 1884, and covered by the following extract from said resolution viz:

"*Resolved*, That the Secetary of War is hereby directed to cause an inquiry to be made on the following points and to report to the Senate: 1. As to the amount and value of all aids and grants of any kind from the United States to the State of Michigan for the Portage Lake and Lake Superior Ship-Canal, or to any agent, trustee, or assignee of said State of any such aids, whether person or corporation, up to the present time, computing the value of any and all lands donated therefor by the General Government at rate of $1.25 per acre. 2. As to all other receipts, whether tolls, grants, privileges, or moneys received by the State of Michigan, direct or through its agents, assignees, &c., aforesaid, for and on account of construction, repair, or operating said canal up to the present time."

* * * * * * *

Should the information requested not be in the records of your office, I beg you will give this application the proper direction, and inform me as to the course the communication has taken.

I am, sir, very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

Hon. HARRY A. CONANT,
Secretary of State, Lansing, Mich.

LETTER OF SECRETARY OF STATE OF MICHIGAN.

MICHIGAN DEPARTMENT OF STATE, OFFICE OF THE SECRETARY,
Lansing, May 13, 1884.

DEAR SIR: In reply to your letter of 10th instant, I have to say that there is nothing in this office to show the amount of aid, &c., granted the Portage Lake and Lake Superior Ship-Canal or the amount of receipts by the canal company. I inclose statement from the State land office, showing the number of acres of land granted by the United States to this State to aid in the construction of the canal. I have no means, however, of knowing how many lands the company got, as the act of the legislature of this State conferring the grant upon this company provided that the title to the lands should fully vest in the company upon the completion of the work and certificate of the governor.

Very respectfully,

HARRY A. CONANT,
Secretary of State.

O. M. POE, Esq.

STATEMENT SHOWING THE NUMBER OF ACRES OF LAND GRANTED BY THE UNITED STATES TO THE STATE OF MICHIGAN TO AID IN THE CONSTRUCTION OF THE PORTAGE LAKE AND LAKE SUPERIOR SHIP-CANAL.

Portage Lake and Lake Superior Ship-Canal.—Marquette district, Michigan.

(State Land Office, Lansing, Mich., May 12, 1884.)

	Acreage.
List No. 1; act of March 3, 1865	192,049.93
List No. 2; act July 3, 1866	37,909.33
List No. 1; act July 3, 1866	49,848.88
Supplemental list No. 1; act July 3, 1866	482.78
Supplemental list No. 2; act July 3, 1866	34,087.91
Supplemental list No. 3; act July 3, 1865	10,729.78
Supplemental list No. 4; act July 3, 1866	23,406.89
Supplemental list No. 5; act July 3, 1866	26,847.63
Supplemental list No. 7; act March 3, 1865	7,949.95
Supplemental list No. 8; act July 3, 1866	9,779.44
Supplemental list No. 9; act March 3, 1865, and July 3, 1866	5,628.00
Total	398,720.52

LETTER OF LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 29, 1884.

SIR: Referring to the certificate of the governor of Michigan, dated June 25, 1875, in the matter of the completion of the Portage Lake and Lake Superior Ship-Canal, I have to request information as to the date when the original company became merged in the Lake Superior Ship-Canal, Railway and Iron Company, and will be under obligation for any furnished.

Very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

Hon. HARRY A. CONANT,
Secretary of State, Lansing, Mich.

LETTER OF SECRETARY OF STATE OF MICHIGAN.

MICHIGAN DEPARTMENT OF STATE, OFFICE OF THE SECRETARY,
Lansing, December 1, 1884.

DEAR SIR: In reply to your letter of the 29th ultimo, I would say the articles of agreement of the Portage Lake and Lake Superior Ship-Canal Company were filed in this office July 15, 1864; amendment filed September 24, 1868; amendment changing name to Lake Superior Ship-Canal, Rail*road* and Iron Company filed May 4, 1871; sold under mortgage and name changed to Lake Superior Ship-Canal, Rail*way* and Iron Company, papers filed May 15, 1877; amended again May 18, 1878, but not to change name.

Very respectfully,

H. A. CONANT,
Secretary of State.

General O. M. POE.

B.

INQUIRIES MADE OF THEO. M. DAVIS, ESQ., PRESIDENT LAKE SUPERIOR SHIP-CANAL, RAILWAY AND IRON COMPANY, BY LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS, U. S. A., UNDER DATE OF JULY 10, 1884, WITH THE REPLIES OF MR. DAVIS UNDER DATE OF JULY 31, 1884.

First inquiry. The number of acres of land donated by the General Government for its construction, and the value thereof, computed at $1.25 per acre?

Reply. The whole number of acres donated by the General Government in aid of the construction of the canal was 400,000, viz, by acts of Congress of March 3, 1865, and July 3, 1866. The value of these, computed at $1.25 per acre, would be $500,000.

These grants were made to the State of Michigan, and the first grant was by the State regranted to the canal company. The second act provided that the grant should inure to the use and benefit of the canal company. In fact, however, the whole number of acres actually certified by the General Government in aid of the construction of said canal was only 398,205.42 acres, which, at $1.25 per acre, amounts to $497,756.77. A large portion of the lands which, under the restrictions of the acts of Congress, the company were obliged to take as part of the grant were entirely worthless, and have, in fact, been abandoned; and all lands, in fact, received by the company from the General Government, directly or through the State of Michigan, which are of any value, could have been purchased of the Government for less than $400,000.

Second inquiry. Was there any aid granted by the State of Michigan? If yes, to what extent? Were there contributions from private parties? If yes, of what character and to what extent?

Reply. No aid was granted by the State of Michigan, nor were there any contributions in aid of the construction of the canal from private parties, other than from the stockholders and creditors of the canal company.

Third inquiry. Whether the receiver or assignee of said canal company received any contribution or aid from any source other than from the stockholders of the company? If so, to what extent?

Reply. The original canal company having failed, proceedings in equity were instituted by its mortgagees and creditors in the circuit court of the United States, under which a receiver was appointed, with authority to borrow money for the purpose of completing the canal, and to secure the same by a first lien on all property of the company. Under this authority said receiver issued and sold certificates, secured as aforesaid, to the amount of $625,300, and actually received and expended in cash, in finishing the canal, $450,180. Neither the receiver nor assignee of said company received any other contributions in aid of the construction of the canal.

Fourth inquiry. What amount has been received for tolls each year since completion of the canal and its acceptance by the State of Michigan?

Reply. I am not able to state the amount received in each year for tolls since the completion of the canal and its acceptance by the State of Michigan, but the gross receipts during that period up to the opening of the canal the present season have been $75,053.13. Reports for the present season are not yet received. (Note by Lieutenant-Colonel Poe. This information is given in detail in Appendix P to Mis. Doc. No. 50, House of Representatives, Forty-eighth Congress, first session.)

Fifth inquiry. Whether there were any "grants, privileges, or moneys received by the State of Michigan direct, or through its agents or assignees, for and on account of construction, repair, or operating said canal up to this present time"?

Reply. I have no knowledge of any such grants, privileges, or moneys as are mentioned in your fifth inquiry.

Sixth inquiry. As to proper cost of construction under the original company, also under the receiver, and the reorganized or new company, showing in the gross sum the entire cost of every kind to final completion and acceptance of said canal by the State of Michigan?

Reply. The officers of the present company have no means of stating the exact amount expended in the proper construction of the canal by the original company, but it is known that said company at the time of its bankruptcy and before the completion of the canal owed on account of mortgage bonds issued to obtain money for the construction of the work $3,300,000 (exclusive of interest). In addition to this there was indebtedness on account of promissory notes to a large but unknown amount. In addition to this there was expended, as above stated, the sum of $450,180 by the receiver. At an investigation before a committee of the present Congress, John H. Forster, an engineer of large experience, who, under appointment by the governor of Michigan, superintended the completion of said canal, testified under oath that from his observation he was of the opinion that the company expended $3,000,000 in the construction of said work. (See Mis. Doc. No. 50, p. 9.)

Seventh inquiry. The cost for each year on account of construction, repairs, and other expenses since completion and acceptance of said canal?

Reply. Since the completion and acceptance of said canal there has been expended for improvements and repairs the sum of $70,146.79, in addition to the expenditures of the present season, the amount of which is not yet reported. These expenditures are exclusive of salaries or other expenses incidental to maintenance of organization.

Eighth inquiry. What part of said construction, repair, or expenses was in the nature of permanent improvements? What portion of such expenditure was ordinary and necessary for annual repairs since canal was completed and accepted, stating amount for each year?

Reply. I have no means of discriminating between the expenditures on account of construction and repairs.

Ninth inquiry. What cost, if any, has been incurred by the State of Michigan, its agents, assignees, or trustees, in operating said canal, or in making repairs or improvements thereon, since date of completion and acceptance of said canal?

Reply. No cost has been incurred by the State of Michigan, its agents, or assignees, or trustees, in operating the canal or in making repairs and improvements, either since the completion and acceptance of the canal or at any other time.

Tenth inquiry. What price will the present owners (the Lake Superior Ship-Canal, Railway and Iron Company) accept for said canal, including franchises, rights of way, piers, and other appurtenances thereto belonging?

Reply. I have no authority to answer your tenth inquiry. It can only be answered by authority of the stockholders at a meeting specially called for the purpose. This will be done and a price fixed whenever the General Government shall confer upon any of its officers authority to treat for the purchase of the canal, rights of way, &c.

Eleventh inquiry. Maps and plans of said canal, showing character and extent of work thereon, as well as all lands included in or covering rights of way or property belonging to the same?

Reply. We are not in possession of the maps required by your eleventh inquiry, but for further information on the subject of that inquiry I respectfully refer you to the testimony of John H. Forster. (House of Representatives, Forty-eighth Congress, Mis. Doc. No. 50, pages 3, 8, 10.)

C.

LETTER FROM LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 10, 1884.

SIR: I am directed by the War Department to use all proper means to obtain the information necessary to enable me to fully comply with the requirements of the resolution of the Senate of the United States (Senate Mis. Doc. No. 83, April 22, 1884), a copy of which is inclosed herewith, and to submit a report thereon.

Much of this information can be obtained from no other source than the company itself, of which you are the president, and I venture to ask you to supply me, at your earliest convenience, with full information upon the points covered by the inclosed memorandum.

It will confer a favor upon me if you will let me know whether you will furnish this and how soon I may expect it.

Very respectfully,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

FREDERICK AYER, Esq.,
President Portage Lake and River Improvement Company.

MEMORANDUM OF INFORMATION DESIRED AS TO THE PORTAGE LAKE AND RIVER IMPROVEMENT COMPANY.

(1) An inventory or schedule of the lands covering rights of ways, piers, docks, and all other property and interests belonging to said company.

(2) A map or maps showing line of canal or improvements and lands through which the same passes, with locality of cuts fully designated.

(3) A plan of cuts showing amount of work done, extent of earth and character of same, and amount of each class (earth, hardpan, or rock) excavated by said company.

(4) Plan of piers and character of work on and in them.

(5) When was this improvement first brought into use for benefit of commerce?

(6) As to the extent of work done on said improvement, including cuts and other dredging, as well as on piers, each year since the date thereof (said first use).

(7) Upon what terms and conditions will the said company transfer all their rights, title, and interest of any and every kind in said improvement, with the appurtenances thereto belonging, to the United States for purposes stated in Senate Mis. Doc. No. 83, April 22, 1884?

LETTER OF S. W. THURLOW, SECRETARY PORTAGE LAKE AND RIVER IMPROVEMENT COMPANY.

PORTAGE LAKE AND RIVER IMPROVEMENT COMPANY,
Lowell, Mass., November 22, 1884.

SIR: Referring to your letter of the 10th of July last, addressed to the president of this company—

The president being absent in Europe, the delay in reply thereto has been unavoidable. I have now the pleasure of submitting the following information, covering, as far as possible, the points of your inquiries:

The improvements of this company were commenced by private individuals, who were subsequently incorporated under laws of the State of Michigan and constituted this present corporation. None of the original proprietors are now connected with the corporation, and I am without data to enable me to state the precise time of the commencement of the work or the exact cost thereof. It appears, however, that the work was so far progressed that the Portage River was opened to navigation in June, 1862, and that at *that* time the following work had been done, viz:

	Yards.
1st cut at entrance, 1,300 feet long, 120 feet wide, 12 feet deep	69,333
Channel along pier, 850 feet long, 100 feet wide, average 7 feet deep	22,037
Channel beyond piers to deep water, 1,500 feet long, 100 feet wide, average 5 feet deep	27,777
1st cut mid-river, 570 feet long, 100 feet wide, 12 feet deep	22,222
2d cut mid-river, 750 feet long, 100 feet wide, 12 feet deep	33,333
3d cut mid-river, 300 feet long, 100 feet wide, 12 feet deep	13,333
4th cut mid-river, 400 feet long, 100 feet wide, 12 feet deep	17,777
5th cut mid-river, 700 feet long, 100 feet wide, 12 feet deep	31,111
Battle Island Channel, 2,500 feet long, 100 feet wide, average 5 feet deep	46,300
Entrance from Portage Lake, 3,000 feet long, 100 feet wide, average 7 feet deep	77,777
	361,000
To this add 10 per cent. for scow measurement	36,100
Total	397,100

Of this original dredging about 136,486 yards was hardpan and bowlders.

This amount of dredging and pier built at entrance, 950 feet long and 12 feet wide, opened up Portage to navigation in June, 1862.

In June, 1863, a contract was let to W. W. Williams to further improve the channels, amounting to $20,000, and this was increased in August, 1864, $6,755.20 more. The price paid Williams was 90 cents per yard for hardpan and bowlders and 30 cents for sand, which latter price would give 66,666 yards by above amount of contracts.

During season of 1875 new cribs were sunk alongside of old pier its entire length, and combined with same by new superstructure from water-line up, thus giving a pier 950 feet long and 28 feet wide, built of heavy timber and filled with rock. In addition to this there were two large cribs carrying "range-lights" at entrance of river from Portage Lake, built of heavy timber and filled with rock at a cost of about $1,000 each.

In 1874 extensive improvements of the channels throughout were begun and continued up to the present time, as follows:

Years.	Sand dredged.	Hardpan dredged.
	Yards.	*Yards.*
1874	72,799	21,750
1877	28,050	6,735
1878	40,086	12,048
1879	30,000	13,763
1880	9,477	8,146
1881	15,500	......
1882	15,725	10,655
1883	14,790	9,255
Total	226,407	81,664

Making total amount of cubic yards dredged from 1874 to 1883, inclusive, 308,071.

From the foregoing description the following summary of original and subsequent work done may be made, viz:

	Feet.
Total length of cuts made through lands of the company	3,950
Length of channel-bed of river improved	5,500
Length of approach made to channel entrance from Lake Superior	2,350

Original amount of dredging prior to 1862 was:

	Cubic yards.
Hardpan and bowlders	136,486
Sand and clay material	260,614
Amount dredged from channels in 1883 and 1884	66,666
And all subsequent dredging was	308,071
Making a total of	771,837

cubic yards dredged, and 11,800 feet of cuts made and channels improved.

Replying to your seventh inquiry, I have to say that the owners of the improvements of this company and of the Lake Superior Ship-Canal (*i. e.*, of the Lake Superior Ship-Canal, Railway, and Iron Company) are to such an extent identical that they would not like to sell one of the improvements without the other. After conference with the owners of a majority of the stock of both corporations I am enabled to inform you that the corporations will sell to the United States both works, viz, the canal known as the Lake Superior Canal, leading from Portage Lake northerly to Lake Superior, and the works and canal leading from Portage Lake southerly to Lake Superior, with all their piers and appurtenances, for the sum of $350,000.

I inclose abstract of title to lands, and will send you by express copy of the only sketch or plan of the works in possession of this company.

Most respectfully,

S. W. THURLOW,
Secretary.

General O. M. POE, U. S. A.

LETTER OF LIEUTENANT-COLONEL O. M. POE.

UNITED STATES ENGINEER OFFICE,
Detroit Mich., November 29, 1884.

SIR: Referring to yours of the 22d instant, conveying certain information in regard to the Portage Lake and River Improvement Company, in response to my letter of inquiry of the 10th July last, and, as the representative of that company and of the Lake Superior Ship-Canal, Railway, and Iron Company, offering to sell the property of both companies to the United States for the sum of $350,000, I find myself somewhat at a loss to determine whether the ultimate cost to the United States would be confined to that sum, or whether it would also involve payment of bonds or outstanding indebtedness in addition to that sum.

It appears that the Portage Lake and Lake Superior Ship-Canal Company, at the time of its bankruptcy and before the completion of the canal, owed on account of mortgage bonds issued to obtain money for the construction of the work, $3,300,000 (exclusive of interest). In addition to this there was indebtedness on account of promissory notes to a large but unknown amount. In addition to this the receiver issued and sold certificates to the amount of $625,300, secured by a first lien on all the property of the company, the proceeds being expended in finishing the canal.

I have therefore to request information on the following points, viz:

What disposition was made of the $3,300,000 bonded indebtedness?

What was the aggregate amount of the promissory notes referred to, and what disposition has been made of them?

What disposition has been made of the $625,306 in certificates?

Is there any other indebtedness in existence, constituting a lien upon the property of this company or its successor, the Lake Superior Ship-Canal, Railway, and Iron Company, and if so, what is the aggregate amount?

Is there any floating debt against said company, and if so, what is the aggregate amount?

It does not appear whether there is or ever was any bonded debt or mortgage on the Portage Lake and River Improvement Company's property, and in order to fully cover this point I have further to request replies to the following inquiries in regard thereto, viz:

Has there ever been or is there now any bonded debt or mortgage lien on the property of the Portage Lake and River Improvement Company, and if so, to what amount, and what disposition has been made of it? What is its present status in this regard?

Is there any floating debt or other lien against the property of said company, and if so, to what amount in the aggregate?

My object in making these inquiries is to ascertain, if practicable, just what the property would cost the United States in case a purchase should be made, and, as time now presses, I will be obliged to you for as early a reply as practicable.

Will you also be so good as to give me the date when the Portage Lake and Lake Superior Ship-Canal Company became merged in the Lake Superior Ship-Canal, Railway, and Iron Company?

I may be in error in asking you to reply to any inquiries in regard to the Lake Superior Ship-Canal, Railway, and Iron Company. If so, I trust you will pardon me, and give that portion of my letter such a direction as will procure the information.

Very respectfully,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

S. W. THURLOW, Esq.,
Secretary Portage Lake and River Improvement Company.

LETTER OF S. W. THURLOW, SECRETARY PORTAGE LAKE AND RIVER IMPROVEMENT COMPANY.

PORTAGE LAKE AND RIVER IMPROVEMENT COMPANY,
Lowell, Mass., December 1, 1884.

SIR: Referring to yours of the 27th instant, I have to say that the offer to you is of a perfect title to both canals, free of all incumbrances, and involving no other payments for bonds or otherwise whatsoever, for the gross sum of $350,000.

And further, answering your inquiries, I have to say—

(1) That the entire property of the Portage Lake and Lake Superior Ship-Canal Company was sold at public auction, under a decree of the circuit court of the United States, confirmed by the Supreme Court of the United States, under proceedings for the foreclosure of liens, that is, the mortgage and receiver's certificates, for $330,000 ($3,300,000?) bonded indebtedness, and the $625,300 receiver's certificates mentioned by you, and was purchased at such sale by the present corporation; that is, the Lake Superior Ship-Canal, Railway, and Iron Company, free from incumbrances. These proceedings discharged the property from all liens or claims on account of the indebtedness of the previous company.

(2) There is not and never was any bonded debt or mortgage on the Portage Lake and River Improvement Company's property.

(3) The sale of the property of the old Portage Lake and Lake Superior Ship-Canal Company, under decree of the United States court, was made by a deed dated the 14th of May, 1877, to A. P. Man and Nathaniel Wilson, who acted as trustees for the creditors. They and their associates were organized as a corporation by force of laws of Michigan, under the name of Lake Superior Ship-Canal, Railway, and Iron Company, and the property was conveyed to the latter company, the present owners, by Man and Wilson, trustees, by a deed dated May 15, 1877.

I believe the foregoing answers all your inquiries; but for greater certainty I repeat that the property would cost the United States, under proposition I have heretofore communicated, just $350,000, and no more.

Most respectfully,

S. W. THURLOW,
Secretary, Portage Lake and River Improvement Company.

General O. M. POE, U. S. A.

L L 16.

PRELIMINARY EXAMINATION OF MACKINAC HARBOR, MICHIGAN, WITH THE VIEW TO ITS IMPROVEMENT.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1884.

SIR: By letter of the 31st July, 1884, from the Office of the Chief of Engineers, I am directed to submit a report upon the results of a preliminary examination of "Mackinac Harbor; and report whether Mackinac Harbor or Mackinac Island Harbor should be improved," and, as required by the river and harbor act of July 5, 1884, also report whether the harbor is worthy of improvement by the General Government.

The preliminary examination was intrusted to Assistant Engineer O. B. Wheeler, a copy of whose report is hereto attached.

I concur in Mr. Wheeler's conclusion that if a harbor is to be constructed, it should be located at Mackinac Harbor or vicinity, rather than at Mackinac Island Harbor, and my preference would be for the bay just west of Old Mackinac Point.

That a harbor of refuge in this locality would be a great convenience there can be no doubt, but to be efficient nearly or quite 2 miles of breakwater would be necessary, the cost of which would not be much, if any, less than $1,500,000.

The effect of this would be to afford shipping a safe harbor without going out of the way from 4 to 7 miles, and notwithstanding the convenience of such a harbor, I cannot bring myself to the conclusion that the object is sufficient to justify the expenditure of so large a sum. It must be borne in mind that it would be under somewhat extraordinary conditions that the harbor would be used.

Ordinary storms do not greatly endanger shipping in the Straits of Mackinac.

Appreciating fully the great magnitude of the commerce through the Straits of Mackinac, I come with great reluctance to the conclusion that such a harbor is not worthy of improvement by the General Government.

But the provision of the act of July 5, 1884, does not necessarily involve a harbor of refuge. A harbor for local purposes is quite as strongly implied. As before remarked, the preferable location would be in the near vicinity of the railroad piers at Mackinac Harbor (Mackinac City). But this locality is naturally protected only from the north, west, and south. To protect it from winds coming from northeast, east, and southeast, artificial protection would have to be supplied.

To do this efficiently would involve the construction of nearly as great a length of breakwater as in the case of a harbor of refuge, the cost would be very great, and it is my opinion that the inconvenience to local interests is not sufficiently great at present to justify the expenditure, and that for that reason the harbor is not worthy of improvement by the General Government.

For the reason that the data now at hand is sufficient for the purpose of making general plans and estimates, no estimate for further surveys is submitted.

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

REPORT OF MR. O. B. WHEELER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 10, 1884.

GENERAL: In accordance with your instructions, I have to report the following results of a preliminary examination to determine, in my own opinion, "whether Mackinac Harbor or Mackinac Island Harbor should be improved," and whether the necessities of commerce require a harbor of refuge at that point to such an extent as to render it worthy of improvement by the General Government, and, if so, to report an estimate of the cost of the necessary detailed examination and survey requisite to clearly present the case, and to prepare plans and estimates of the cost of carrying them into effect.

The Straits of Mackinac are 3½ miles wide at the narrowest point, with Mackinac City on the south side and Saint Ignace on the north side.

The railroad docks at these two places are in bays, on the east of points, and are 6 miles apart. The harbor at Mackinac Island is 7 miles from that at Mackinac City, and 5 miles from that at Saint Ignace. The harbor at Mackinac City is the one styled Mackinac Harbor, and on this are the docks of two railroad companies, and ferries cross from it to the railroad docks at Saint Ignace.

Lake commerce to and from Lake Michigan passing through the straits, and the railroad traffic by ferry across the straits must, of necessity, pass near or through Mackinac Harbor, but do not necessarily pass near Mackinac Island Harbor. The most frequented route between Lakes Huron and Michigan is by the channel south of Bois Blanc Island, and that between Lakes Michigan and Superior is north of this island, and between it and Mackinac Island. But navigation by either of these routes must pass within a mile or two of Mackinac Harbor, while that by only one route passes near Mackinac Island Harbor. A local line of steamers from Cleveland and Detroit touches at Mackinac Island in passing to Saint Ignace, but does not make the Mackinac Harbor.

In the Report of the Chief of Engineers, for 1880, page 2056, by Major Harwood, Corps of Engineers, it was found, after making a detailed survey, that it was impracticable to make a small, snug harbor at Mackinac Island, on account of a deep hole off the harbor in the direction of the heaviest seas. A study of the Lake Survey detail charts shows that it would be equally impracticable to make a commodious harbor of refuge, for the reason of too deep water in the same direction. The anchorage here is rocky for the most part, and not good, while that in East Bay, at Mackinac City, is sandy and good.

The even slope of bottom in East Bay would make it practicable to place piers at any desired depth, but in order to get a commodious harbor with entire protection from southeastern storms, the piers must be from 1¼ miles to 2 miles in length. From the above facts, in my opinion, it is evident that the improvement by the General Government should be at Mackinac Harbor, rather than at Mackinac Island Harbor.

In conversation with navigators of many years' experience upon lakes Huron and Michigan, I find the feeling is uniformly one that when they are in the vicinity of the Straits of Mackinac they are near a natural harbor of refuge. From southeastern storms there is shelter at McLeod's Bay and in the lee of Bois Blanc Island or of McGulpin's Point, or of Mackinac Island.

From southwestern or western or northwestern storms there is lee at Saint Helena Island, and a good harbor at East Bay, Mackinac City.

Of the three ports in the straits it is probable that Saint Ignace will be of the greatest commercial importance locally, for it is the terminus of two local lines of steamers and the railroad traffic is through it, and it is also likely to receive the advantages that a city situated on the western side of a river receives in our country. All three of these ports may at some future day be of sufficient local importance to require the assistance of the General Government in protecting their dockage from severe southeastern storms. The seas from such a storm, coming from the two sides of Mackinac Island and meeting at Saint Ignace, are said to cause great inconvenience.

If a harbor of refuge is to be built in the straits, the natural advantages of the bay to the north of Mackinac City must be considered. In a northwesterly direction from a point on shore, at the terminus of the county line between Emmet and Cheboygan counties, is found a shoal extending 3,500 feet from shore, and from a point 1½ miles westward alongshore is found a shoal extending a greater distance to the northeast. Upon these shoals converging piers could be built, leaving an opening of 2,000 feet width at their extremities. This opening would be opposite the mainland of the northern peninsula, and heavy seas would not be directed towards it. The anchorage here is probably not as good as in East Bay, the bottom being hard gravel.

In conclusion, I find, in my opinion, that the improvement of a harbor of refuge in the Straits of Mackinac should be at Mackinac Harbor rather than at Mackinac Island Harbor, but that the necessities of commerce do not demand such a harbor at either place, and that the work is not worthy of improvement by the General Government.

Very respectfully, your obedient servant,

O. B. WHEELER,
Assistant Engineer.

Lieut. Col. O. M. POE,
Corps Engineers, U. S. A.

L L 17.

PRELIMINARY EXAMINATION OF PINE RIVER, SAINT CLAIR COUNTY, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1884.

SIR: I have the honor to submit the following reports upon the results of a preliminary examination of Pine River, Saint Clair County, Michigan, provided for in the river and harbor act of July 5, 1884, and to express an opinion as therein required.

Pine River is a small stream lying throughout its whole course within the limits of Saint Clair County. Its length, in a straight line from its source to its mouth, at the town of Saint Clair, is about 25 miles, but, owing to its tortuous course, its real length is considerably more, and in its lower portion it has a greater depth of water than is usual in streams of its class.

In June, 1873, a good survey was made of it from its mouth to its point, about 5½ miles up-stream. The map of this survey is now in this office, and is amply sufficient for the purpose of making plans and estimates for any improvement yet proposed.

In 1875–'76 Pine River was improved, by dredging, from its junction with the Saint Clair to a point about 4,000 feet up-stream. The channel then made was 100 feet wide and 12 feet deep, and, owing to the staple character of the material, remains as good now as when made. It has been and continues to be of great service to local interests. Upon inquiry of persons interested in the locality, at whose instance the provision for an examination and survey was inserted in the act, it was ascertained that the object was to procure the further improvement of the river for a distance of about 2,500 feet, in order to obtain a depth of 12 feet in the channel to the possible site of three salt manufactories, and also to a brick-yard in which two millions of brick were manufactured during the season. I could learn of no other interests to be subserved, and the question at once arises whether these are sufficient to warrant me in expressing an opinion that the river is worthy of improvement by the General Government. The way to determine this is to compare the probable cost of such improvement with the interests to be benefited. The accompanying report, by Assistant Engineer O. B. Wheeler, shows that to extend the improvement as described would require the removal of about 28,000 cubic yards of material, and my estimate of the cost of doing it is as follows, viz:

Dredging 28,000 cubic yards, at 25 cents per cubic yard	$7,000
Add 10 per cent. for contingencies	700
Total	7,700

The immediate benefit arising from the expenditure of this sum would be to save the cost of lightering the product of the brick-yard referred to. This does not seem to me to be a sufficient object to justify me in expressing the opinion that the river is worthy of improvement by the General Government. Mr. Wheeler, from the same data, has reached a different conclusion. I may remark that his opinions are entitled to great weight, and I regret that I feel compelled to differ from him.

Should the manufacturing interests above the present improved channel increase to a sufficient extent in the future to justify it, I will gladly modify my opinion.

For the reason given above (sufficient data already at hand), I do not recommend any further survey or examination, and therefore do not submit any estimate of the cost.

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. O. B. WHEELER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., October 21, 1884.

GENERAL: I have the honor to report the following results of a preliminary examination to determine whether, in my opinion, the necessities of commerce require the improvement, by the General Government, of Pine River, Saint Clair County, Michigan.

In June, 1873, a complete survey of this river from and including the bar at its mouth to Cox's Bridge, a distance of 5¼ miles by river channel, was made under the direction of General Weitzel, Corps of Engineers. The chart from this survey is reliable for the present time, for the changes have been very slight since that date.

On the 6th instant, according to your instructions, I made a hasty examination of the river from its mouth to the Town-line Bridge, a distance of 4 miles.

The letter of Col. Henry Whiting to you, bearing date October 3, 1884, gives definitely the interests involved and the improvement desired. The bed of this sluggish stream is in blue clay, and the banks are capped with a stratum of good tile clay and sodded down to the water's edge. The surveyed channel of 5¼ miles lies wholly within 1.7 miles from the river's mouth, so the river is very tortuous, and deep holes at the bends, with shoaling bars below the bends, are found.

The river carries, however, a channel in the upper parts of the surveyed portion. of 75 feet in width by 5 to 6 feet in depth over the shallowest places, and in that portion where improvement is desired the channel is about 100 feet by 8 to 9 feet in the shallowest place.

In 1875–'76 the bar, and the river to a distance of 4,000 feet, was dredged 100 feet wide to a depth of 12 feet, under an appropriation of $5,000. (See Reports of the Chief of Engineers, U. S. A., for 1875, Vol. II, Part 1, page 280, and for 1876, Vol. II, Part II, page 541.) The present contemplated improvement is to continue this width and depth of channel a distance of 2,500 feet to a point just above the first severe bend. The amount of earth and driftwood to be removed would be about 3 feet by 100 feet by 2,500 feet, or about 28,000 cubic yards.

The work when done would be of a permanent character on account of the stability of the channel and river banks.

Driftwood would occasionally find a lodgment and have to be removed. Vessels loaded to 12½ feet of water have this season gone out safely from the brick-yard one-half mile from the river's mouth. The harbor is used as an ice-harbor to some extent. I find, in my opinion, that the work is worthy of improvement by the General Government. No further survey would be necessary upon which to base specifications for the work.

Very respectfully, your obedient servant,

O. B. WHEELER,
Assistant Engineer.

Lieut. Col. O. M. POE,
Corps of Engineers, U. S. A.

L L 18.

PRELIMINARY EXAMINATION WITH A VIEW TO MAKING A HARBOR OF REFUGE AT CROSS VILLAGE, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1884.

SIR: I have the honor to transmit herewith a copy of a report by Assistant Engineer O. B. Wheeler, dated October 16, 1884, upon the results of a preliminary examination to determine whether the necessities of commerce require the construction of a "breakwater at or near Cross Village, in Michigan, * * * with a view to making a harbor of refuge at" that point, to such an extent as to render it worthy of improvement by the General Government.

In transmitting Mr. Wheeler's report I have to say that it has been in my hands for some time, that I have carefully considered all the points covered by him, and that I have arrived at the same conclusions. To restate them would be merely to repeat his report, and this would seem unnecessary. It appearing that a work of such magnitude as this, would not at this time, nor in the near future, subserve any purpose at all commensurate with its cost, I have reluctantly to report that in my opinion it is not worthy of improvement by the General Government, and I therefore do not submit any estimate of the cost of further surveys.

Indeed the data at hand will serve all purposes of preparing plans and estimate for the work, should they be called for.

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF of ENGINEERS, U. S. A.

REPORT OF MR. O. B. WHEELER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., October 16, 1884.

GENERAL: In accordance with your instructions, I have to report the following results of a preliminary examination to determine whether, in my opinion, the necessities of commerce require the construction of "a breakwater at or near Cross Village, in Michigan, * * * with a view to making a harbor of refuge at" that point, to such an extent as to render it worthy of improvement by the General Government, and, if so, to submit estimates of the cost of making a further and more complete survey of the locality.

It was considered that sufficient data were at hand for this examination without personally visiting the locality. There are available the published charts and tracings from the detail manuscript of the United States Lake Survey, and a tracing from a detail manuscript chart resulting from a survey at Cross Village, made under the direction of Captain Lockwood, Corps of Engineers, in September, 1883, when the making of a harbor only was contemplated. There is also the opportunity of consulting navigators who frequent the locality in regard to the desirability or use that would be made of such a harbor of refuge.

The published charts show a channel between Beaver Island, on the west, and the mainland of Michigan, on the east, of 18 miles in the narrowest part, and of 26 miles in the widest part, mid-channel being from only 9 to 13 miles from either shore. The contemplated improvement would be about abreast the center of Beaver Island, on the opposite side of the channel. The sailing directions of the charts, founded on the requirements of navigation, show that the principal lines of navigation are entirely to the westward of Skillagallee light-house, which light-house is on an island 7 miles west-northwest from Cross Village.

For a most exposed locality, say from 10 to 15 miles from the south end of Beaver Island, and in any direction from southeast to south from the south end of the island, the excellent harbors of Northport Bay and Little Traverse Bay are accessible at a shorter distance than would be a harbor at Cross Village, and for any point in the line of navigation east of Beaver Island, the land-locked Beaver Harbor, at the north end of Beaver Island, is a harbor of refuge at almost the same distance that a harbor at Cross Village would be.

From the masters of sailing vessels and steamers, I learn that a harbor of refuge at Cross Village would seldom be resorted to by vessels on the principal lines of navigation. The masters of sailing vessels would prefer the lee of the islands or mainland for shelter, where there would be less hindrance in getting away again than in a close harbor of refuge. There is good anchorage ground on either coast, and the deep bay on the east side of Beaver Island is considered a safe harbor for all westerly winds. The masters of steamers would as soon resort to the at present sufficiently commodious Beaver Harbor or to the Northport Bay Harbor. It would seem, then, that a harbor of refuge at or near Cross Village would be of only local importance. There is but one local line of steamers and but one steamer, the City of Grand Rapids, on that line. There are also a few sailing vessels, of local importance only, carrying lumber, wood, fish, &c. About the lakes there are many more exposed stretches of coast, where the water traffic is greater and the desirability of a harbor of refuge more manifest.

If a further survey is to be made, it should be, in my opinion, at a point 3¼ miles northeasterly from Cross Village, where a shoal extends a half mile from shore, with only 6 feet of water at 2,000 feet from shore; and in a bay immediately to the eastward of this rocky, shoaly point, the 18-foot curve is within 1,000 feet from shore. At Cross Village the 18-foot curve is also about 1,000 feet from shore, but the protecting shoal to the westward has from 12 to 18 feet of water within the limits of from 1,000 to 3,000 feet from shore.

When the requirements of commerce demand it, the capacity of Beaver Harbor can be greatly increased by cutting through the bar (or ledge) which separates the second, interior, harbor from the main harbor.

In conclusion, I find that, in my opinion, the work of constructing "a breakwater at or near Cross Village, in Michigan * * * with a view of making a harbor of refuge at Cross Village," is not worthy of improvement by the General Government.

Very respectfully, your obedient servant,

O. B. WHEELER,
Assistant Engineer.

Lieut. Col. O. M. POE,
Corps of Engineers, U. S. A.

L L 19.

REPORT RESPECTING USE OF OLD LOCKS AT THE SAINT MARY'S FALLS CANAL AS A DRY-DOCK.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1884.

SIR: The river and harbor act of July 5, 1884, contains the following provision, viz:

> The State of Michigan having tendered to the United States the balance of tolls received by the State before the surrender of the Saint Mary's Falls Ship-Canal to aid in constructing a dry-dock at the canal, such balance being about $60,000, the Secretary of War has directed to cause plans, estimates, and specifications for such dry-dock above the locks, and also to report whether the old locks can be used for a dry-dock, and the cost of fitting the same for the purpose.

And, by letter from the office of the Chief of Engineers, dated July 31, 1884, I was instructed to submit, as soon as practicable, an estimate of the probable amount of funds required for such an examination as might be necessary to enable me to report whether the work is worthy of improvement by the General Government.

With my annual report for the fiscal year ending June 30, 1884, I had the honor to report upon this very question, and expressed the opinion that under the provisions of the transfer of the canal to the United States and its acceptance by them, the General Government was bound to establish a dry-dock at Saint Mary's Falls Canal, and also intimated, as strongly as I felt warranted under the circumstances, that the construction of a dry-dock at that place could not be otherwise than detrimental to the interests of the canal, as well as cause the Government to enter into competition in a business which fairly belongs to private enterprise.

Considering the question at that time no longer open to discussion, I proceeded to give estimates for a dry-dock at three separate sites, viz:

For a dry-dock north of the canal; for a dry-dock on the south side of the canal, near the new lock; for a dry-dock near the east end of the area transferred from the Fort Brady military reservation to the canal reservation. And because I was of opinion that under no circumstances should the old locks be permanently adapted to the purposes of a dry-dock, I gave no estimate of the cost of doing so. I also stated my objections to locating a dry-dock on either side of the canal in the vicinity of the locks.

Since the preparation of that report, I have thought much upon the subject, and with the experience of this season all the objections stated in my annual report are greatly strengthened. The commerce through the canal has increased so rapidly within the last few years that before the 1st of July last it became evident that it is only a question of a very short time when the present facilities will be found insufficient for the wants of commerce. Consequently I prepared a report recommending the reconstruction of the old locks, and submitted an estimate of the cost of doing so. I stated that at the rate of increase which had prevailed for some years past the limit of the capacity of the locks would be reached in eight or nine years, and that the work of reconstruction could not be undertaken too soon, nor be prosecuted too vigorously, because with every possible effort the reconstructed lock would be required before it could be completed, even if the past rate of increase in the commerce were not exceeded.

But with all my experience I was not prepared for such an increase in this rate as has actually occurred this season, and if it be maintained (and I see no reason why it should not be exceeded next season), the limit of time within which the full capacity of the lockage system will be reached must be reduced from eight or nine years to five or six.

Such a statement is sufficiently startling; and when coupled with the remark that were *all* the funds covered by my estimate immediately available it would hardly be possible to complete the work of reconstruction and enlargement in time, the objection to any modification of the old locks to adapt them to dry-dock purposes becomes overwhelming.

Nor can such a work be located above the locks without being either insufficient in itself or materially interfering with the use of the locks and canal.

The location to which there are the fewest objections, is that entirely below the canal—that is, the last one of those designated above. But that site is not covered by the act of July 5, 1884, and I therefore limit myself simply to mentioning it.

My conclusions in the matter referred to me is, that no dry-dock should be built above the locks in connection with the canal, nor should the old locks be used for such purpose; and holding such views I must report that the work is not worthy of improvement by the General Government.

Plans and estimates for a dry-dock above the locks, and for modifying the old locks to adapt them to dry-dock purposes, are in course of preparation by the engineering force permanently employed, and will involve no additional expenditure, for which reason no estimate is submitted.

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

SUPPLEMENTAL REPORT.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., December 3, 1884.

SIR: I have the honor to inclose herewith a report just received, in regard to the use made of the old locks at Saint Mary's Falls Canal for dry-dock purposes, and request that this communication and its inclosure be appended to my report of November 13, upon the question of converting these locks into a dry-dock. Attention is especially invited to the following facts, viz:

(1) In the four seasons during which the Government has had charge, the locks being available for dry-dock purposes whenever desired, they have been so used an aggregate of only 344½ hours.

(2) This use of the locks was divided as follows, viz:

	Hours.
Local craft, including dredges	144½
Trading to the Sault	30
Trading to Lake Superior	170
Total	344½

That is to say, the general commerce to and from Lake Superior made use of the locks for dry-dock purposes an aggregate of only 170 hours in four years.

(3) The local craft using the locks for dry-dock purposes were all small, and could readily have been accommodated by a structure of much smaller dimensions and cost than the old locks.

It seems to me that these statistics emphasize in the strongest degree my opinion that no dry-dock should be built by the Government for use in connection with the canal.

I am, sir, very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. E. S. WHEELER, GENERAL SUPERINTENDENT.

OFFICE OF SAINT MARY'S FALLS CANAL,
Sault Sainte Marie, Mich., December 2, 1884.

COLONEL: I have the honor to transmit herewith a report of the dry-docking of vessels and other craft in the old locks of the Saint Mary's Falls Canal since it was transferred to the United States on June 9, 1881.

It is shown by this report that the locks were used for this purpose, as follows:

	Hours.
In the season of 1881	13
In the season of 1882	59
In the season of 1883	147
In the season of 1884	125¼

giving a total of 344¼ hours in the four seasons during which the General Government has controlled the canal.

It would seem from an examination of the reports made by the canal superintendents, while it was in the hands of the State of Michigan, that no regular records were kept of vessels dry-docking in the locks, thus rendering further data on this subject unobtainable.

Very respectfully, your obedient servant,

E. S. WHEELER,
General Superintendent.

Lieut. Col. O. M. POE,
Corps of Engineers, U. S. A.

Statement of vessels and other craft dry-docked in old locks of the Saint Mary's Falls Canal since canal was transferred to United States, June 9, 1881.

SEASON OF 1881.

[Canal open June 9 to December 5.]

Date.	Name.	Class.	Local or trading.	Number of hours in locks.
Aug. 3	William Goodnow	Lake tug	Trading to Lake Superior.	1
Sept. 19	Relief	Wrecking tug		3
Oct. 24	Houghton	River tug	Local	9
	Total			13

SEASON OF 1882.

[Canal open April 21 to December 3.]

Date.	Name.	Class.	Local or trading.	Number of hours in locks.
Apr. 19	Houghton	River tug	Local	6
22	Mystic	do	do	8
26	Quebec	Passenger propeller	Canadian	15
26	Bertha Endress	Fish tug	Local	1
27	Ste. Marie	Passenger propeller	do	1
July 6	James Reid	River tug	Trading to Sault	6
7	Montcalm	Schooner	Trading to Lake Superior.	6
9	Ste. Marie	Passenger propeller	Local	1
Aug. 17	Charles Riter	River tug	do	1
Sept. 4	Ontario	Passenger propeller	Canadian	1
15	Ste. Marie	do	Local	1
25	Antelope	Ferry tug	do	1
Oct. 14	H. B. Tuttle	Freight propeller	Trading to Lake Superior.	11
	Total			59

Statement of vessels and other craft dry-docked in old locks, &c.—Continued.

SEASON OF 1883.

[Canal open May 2 to December 11.]

Date.		Name.	Class.	Local or trading.	Number of hours in locks.
Apr.	27	Wm. H. Seymour	River tug	Local	6
	27	Ste. Marie	Passenger propeller	do	2
	28	Houghton and Scow	River tug	do	8¼
	28	Dump Scow		do	3
	30	Dredge and Scow		do	7¾
May	1	Dredge		do	8¼
	3	do		do	3½
	17	Houghton	River tug	do	4
	26	do	do	do	4
June	6	D. D. Porter	Lake tug	Trading to Lake Superior.	1
	5	Houghton	River tug	Local	1
	6	do	do	do	3
	7	do	do	do	3
	10	Bertha Endress	Fish tug	do	4
July	1	Ste. Marie	Passenger propeller	do	3
	8	A. C. Van Raalte	do	Trading to Sault	2
	26	John Hickler	River tug	Local	4
Aug.	13	Cumberland	Freight propeller	Trading to Lake Superior.	41
Sept.	11	Remora	Passenger propeller	Trading to Sault	10
Nov.	17	Ontario	do	Canadian	10
	27	Chas. M. Riter	River tug	Local	18
		Total			147

SEASON OF 1884.

[Canal open April 23 to December 10.]

Date.		Name.	Class.	Local or trading.	Number of hours in locks.
May	12	Pacific	Freight propeller	Trading to Lake Superior.	9
	12	Dredge		Local	25¼
	14	Antelope	Ferry tug	do	3
	25	S. C. Baldwin	Freight propeller	Trading to Lake Superior.	41
June	23	Wm. Goodnow	Lake tug	do	6
July	2	Ste. Marie	Passenger propeller	Local	1
	15	Jay Gould	Freight propeller	Trading to Lake Superior.	23
Aug.	11	Antelope	Ferry tug	Local	1
	16	Mystic	River tug	do	2
Sept.	25	Sam Flint	Schooner	Trading to Lake Superior.	11
Oct.	5	Lady McDonald	do	do	1
Nov.	..	Van Raalte	Passenger propeller	Trading to Sault	2
		Total			125¼

L L 20.

PRELIMINARY EXAMINATION OF CLINTON RIVER, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1884.

SIR: By letter of instructions from the office of the Chief of Engineers, dated July 31, 1884, I am directed to make a preliminary examination of Clinton River, Michigan, and to report, whether in my opinion, the river is worthy of improvement by the General Government.

Clinton River is a comparatively small stream having its source in the northeastern part of Oakland County, and flowing in a southeasterly direction, empties into Lake Saint Clair, its whole length being possibly 50 miles.

The railway bridge at Mount Clemens may be considered the head of navigation, notwithstanding the fact that the bridge is provided with a draw. The distance from the old light-house at the mouth of the river to this bridge is 7½ miles by the course of the stream, and a little less than 5 miles in a straight line. The average depth of water within these limits is about 10 feet, the shallowest spot, a short distance below the railroad bridge, having 5 feet upon it, but the channel is narrow and crooked.

A survey made in 1879 revealed but three obstructions of any moment between the mouth of the river and the railway bridge, viz, a shoal opposite the saw-mill at the easterly outskirts of Mount Clemens, the curves in the river in the vicinity of Shoemaker's farm, including the "island" (a shoal), and the channel entrance at the mouth of the river.

After the results of this survey were known, Major Harwood, then in charge of the work, estimated that $25,000 would be required to remove the obstructions named and permanently improve the channel across the bar at the mouth.

The expenditure of subsequent appropriation resulted in structures which Major Harwood estimated as worth $5,000 towards the completion of the project, and in 1882 he estimated that $20,000 would yet be required. In my annual report for 1883 I referred to this estimate and expressed the opinion that it was entirely too low, and I have as yet seen no reason for modifying my opinion. Early in the present season two small steamboats made daily trips between Detroit and Mount Clemens, but later the larger of the two was withdrawn, presumably because the enterprise was not profitable.

The business of these boats consisted principally in the transportation of excursionists between the two places, doing so at less price than was charged by the railroad, but taking longer time with the advantage of a journey by water.

In 1876 it was reported that the "trade of the river is confined altogether to the carrying of cord-wood to the Detroit market." (See Appendix A A 13, Annual Report of the Chief of Engineers, 1876.)

In 1879 the shipments to and from Mount Clemens were reported as follows, viz:

Lumber	feet B. M.	2,623,148
Logs	do	3,300,000
Staves	do	6,577,950
Shingles	do	1,700,000
Lath	do	605,500
Headings	do	18,000
Stave-bolts	cords	3,500
Cord-wood	do	5,000

(See Appendix G G 23, Annual Report of the Chief of Engineers for 1880.)

During the fiscal year ending June 30, 1881, the number of vessels entering and clearing at Clinton River was 342, with a tonnage of 12,580. (See Appendix I I 21, Annual Report of the Chief of Engineers for 1881.)

Of course it must be understood that the same vessels entered and cleared many times.

During the fiscal year ending June 30, 1882, the entrances and clearances numbered 447, with a tonnage of 33,525. (See Annual Report of the Chief of Engineers for 1882.)

I find myself quite unable to reconcile this 166 per cent. increase in tonnage with an increase of only 30 per cent. in the number of entrances and clearances, as it is not at all likely that many vessels entered and cleared in 1882 that were not in the same trade in 1881.

But the statistics show that there is commerce to and from Clinton River worth considering. To how great an extent this commerce can be benefited by improving the river, and at what cost, is quite another question. Thus far this season I have heard no complaint of insufficiency of depth in the channel. There is no doubt but the navigation can be materially improved with the amount of the estimate included in my annual report for the fiscal year ending June 30, 1884, and upon the whole, considering that about $20,000 have already been expended here by the General Government, I am of opinion that the river is worthy of improvement by the General Government.

Having, with much misgiving, reached this conclusion, I have to submit the following estimate of the cost of making a survey and examination upon which to base plans and estimates of cost of the requisite improvement:

1 assistant engineer, one month	$175 00
2 leadsmen, 1 month each, 60 days, at $2.50 per day	150 00
4 axemen, 1 month each, 120 days, at $2.50 per day	240 00
Transportation	50 00
10 per cent. for contingencies	61 50
Total	676 50

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF MOUTH OF CLINTON RIVER, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., January 23, 1885.

SIR: In obedience to instructions conveyed by your letter of November 21, 1884, I have the honor to submit herewith the results of an examination and survey of the mouth of Clinton River, Michigan, made between the 5th and 20th January, 1885.

The appended report by Assistant Engineer B. H. Muehle, describes the present condition of the improvement, and includes a plan, with estimates of cost, of a revetment on the northern side of the channel, to be composed of piles, sheathing, cedar bark, and materials dredged from the channel.

It will be observed that this plan differs in details from that proposed by the Board of Engineers, convened by Special Orders No. 92, headquarters Corps of Engineers, July 27, 1880, and now constituting the approved project.

The principal differences are comprised in the plan for protecting the dredged channel, and in the cross-section of this channel.

I concur with Mr. Muehle in regard to the channel protection, but do not think it necessary to make the channel more than 8 feet in depth for a width of 60 feet at the bottom and 100 at the top. This is practically so much of Major Harwood's project of May 22, 1880, as relates to the improvement at the mouth of the river, and conforms to the project of the Board of Engineers. Major Harwood's estimate of the probable cost of his project was $25,000.

In my annual report for the fiscal year ending June 30, 1883, I expressed the opinion that this estimate of the ultimate cost of the work was entirely too low, and I am still of that opinion.

Mr. Mueble estimates the cost of the plan proposed by him at $21,806. This may suffice for the work recommended at the mouth of the river, but it will be observed that it does not include any that may be needed above, to make the full depth available from there to Mount Clemens, and which I estimate at $11,120, or a total of $32,926.

Appropriations made since the date of Major Harwood's report of May 22, 1880, have been expended, as explained in the correspondence of that officer, in temporary expedients to give immediate relief to the navigation.

The map of the mouth of the river, transmitted herewith, shows, however, that the result has been better than he expected, and there is at this moment a navigable channel of 7 feet in depth from Lake Saint Clair into the river. Of course this is deteriorating all the time, but not so rapidly as before the mattress work was put in place.

The present depth of channel is not entirely due, however, to the works already constructed, as in the spring of 1884 the people of Mount Clemens contributed to a fund which was expended in deepening the channel from Lake Saint Clair to that place. The outer bar had but 5½ feet upon it at that time.

The plan now proposed is not free from objection, since the work projected will be subject to injury to an unknown extent, from the effect of floating ice and the action of waves upon the north side of the earth deposited behind the revetment. But it is the best that can be devised at a probable cost within reasonable limits, and, in my opinion, should be carried out.

Clinton River is situated in the collection district of Detroit, which is the nearest port of entry, but the commercial statistics of which have, however, no bearing upon the commerce of Clinton River. The latter is purely local, and fully described in the appended papers.

The nearest fort is Fort Wayne, Michigan, and the nearest light-house Saint Clair Flats beacon.

Accompanying this report will be found the following maps,* viz:

1. A sketch of the northwestern part of Lake Saint Clair, showing channel of entrance at the mouth of Clinton River.
2. Map of the mouth of Clinton River, Michigan, from survey made in January, 1885.
3. Plan of the pile revetment proposed for the mouth of Clinton River.

Very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. B. H. MUEHLE, ASSISTANT ENGINEER.

MOUNT CLEMENS, MICH., *January* 20, 1885.

GENERAL: In obedience to your instructions of the 26th of December, 1884, viz, to make an ice survey at the mouth of Clinton River, Michigan, and to submit a project of improvement, I proceeded on the 5th day of January, 1885, to Mount Clemens, Mich., which I found to be the only convenient place with suitable accommodations for myself and party, 5 miles west of the mouth of the river, and with abundant facilities for means of transportation of party. On my first visit to the mouth of Clinton

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* Omitted.

River I discovered that although there was plenty of ice in the lower reach of the river, and in the bay to the northward of the outer channel, as well as in Lake Saint Clair reaching south, the greater portion of the area to be examined was entirely free from ice, and I was informed that it seldom froze over, and then only for a short time, as, for instance, during the extremely cold weather in the last month.

There being no immediate prospect of colder weather, I determined to make the survey part on ice and part by water, and provided myself with the necessary boats, buoys, ropes, and anchors. The soundings taken were reduced and platted from day to day, and the out-door work of the survey completed on the 19th day of January, the time occupied as compared with the number of soundings being greatly in excess of my calculations, but easily accounted for by the extremely difficult as well as dangerous nature of the work, and the very changeable weather prevailing during the time. However, 2,734 soundings were taken on 114 cross-sectional lines, sufficient to clearly show the present condition of the channel, and as a basis for calculations for proposed dredging operations.

A tracing of the survey, herewith respectfully submitted, shows the soundings taken, with the 3, 6, 8, 9, 10, and 12 foot curves and plan of improvement illustrative of the project hereinafter described.

The channel at the mouth of Clinton River, which was dredged in August, September, and October, 1881, to a depth of 8 feet, and redredged in September and October of 1882, 60 feet wide and 9 feet deep, has in many places filled up again in consequence of the inadequacy of the channel protection constructed during those years, consisting of a line of brush mattresses 30 feet wide and 1 foot thick, which was laid on a loose bank of dredged material (principally sand) thrown up along the northerly boundary of the dredge cut, and backed on the north side by a line of twenty-three clusters of piles. The mattresses and piles as well as the pile crib at the outer terminus of the channel are substantially in the same condition as reported by me to Maj. F. U. Farquhar, Corps of Engineers, U. S. Army, under date April 27, 1883. There is from 6 inches to 2 feet of water over the crest of the mattress, according to standard low water, which was the basis for dredging; adding the usual stage of water, *i. e.*, 1 foot above zero, and in the spring of the year 2 to 3 feet additional, it will be seen that the mattress in its present condition and position affords no protection whatever to the channel, and that the latter is filled up with sand principally carried over and around the mattress work by the littoral current following the shore of Anchor Bay from the mouth of the Saint Clair River to this locality. In my report to Maj. F. Harwood, Corps of Engineers, U. S. Army, in connection with the resurvey of Clinton River, dated May 17, 1880, I recommended a channel protection composed of a pile revetment upon the north side of the outer channel to be dredged, the excavated material to be thrown behind the pier. This plan was indorsed and submitted by Major Harwood, but by direction of a Board of Engineer Officers, constituted by Special Orders No. 92, headquarters Corps of Engineers, U. S. Army, the channel was dredged 60 feet wide and the sand thrown on the edge of the cut in a continuous bank, the latter to be sown with wild rice or covered with a brush mattress. The clusters of piles were provided as a protection to the mattressed bank from ice, and the pile crib to mark the outer terminus of the channel and bank. The attempt to sow wild rice proved a failure, owing to the softness of the material composing the bank and the settling of its crest below the water line. Along the outer half of the channel, where deeper water prevails, the clusters of piles could not all withstand the pressure of the ice, and the mattress work was partially destroyed. In the shoaler portion, just outside of the old light-house, where the clusters were placed closer together, both the piles and mattresses are in good preservation, though the latter are below the water surface, as above described.

Assuming, then, that mattress protection of the channel bank may be practicable if carried to a sufficient height above the water level, its expense is the most important item to be considered. The actual expense of 600 linear feet of the mattress work and piling, according to a report dated July 11, 1882, was as follows:

MATTRESS.

Brush	$40 45
Stone	787 35
Lumber	32 62
Ropes and sundries	77 23
Labor	661 83
Tug hire	119 50
Boat hire	26 50
Superintendence	364 00
Traveling expenses	52 83
Sundries	16 69
	2,179 00

PILING.

Piles	$350 00
Chains, &c	44 68
Labor	35 00
	429 68

or $3.63 per linear foot.

A height of at least 5 feet above low water being deemed sufficient, the cost to complete the protection-wall on this plan would be at the rate of $18.15 per linear foot, a sum much in excess of what a more durable structure may be built for. I therefore respectfully recommend that the further extension of the mattress work be abandoned and a pile revetment-pier, with plank sheathing and cedar-bark backing, be substituted therefor in the projects for improvement of the channel at the mouth of Clinton River, and beg leave to submit a plan of such a revetment, with brief description, bill of material, and estimate of cost of construction. The estimate for piling and cedar bark is based on the prices paid on the Saint Clair Flats Canal, and it is believed that bark may be obtained at a still cheaper rate in Detroit to-day. The proposed revetment-pier should extend from a point on the north shore and a short distance west of the mouth of the river, to the channel-face of the outer pile-crib, a distance of about 3,280 linear feet, running close to the south line of the mattress work, which may be utilized as part of the filling. It is especially necessary to close up the gap between the mouth of the river and the old light-house crib, inasmuch as the stiff current prevailing from north to south across the channel at this locality appears to be the main cause of the shoaling of the latter.

In this connection I beg leave to call attention to the so-called Cat-fish or Blind Channel, about three-fourths mile west of the old light-house, which connects the bay with the river, and shows a strong current in the same direction. Much sand is doubtless brought into the river through this channel; hence it will be advisable to also close this gap by a filling of cedar bark and sand, or some other inexpensive method.

A channel along the south side of the revetment, 100 feet wide and 10 feet deep, connecting the 10-foot curve in the river with that in Lake Saint Clair, will be sufficient for the accommodation of the shipping of Clinton River. Aside from a number of bars, shoals, and short bends in the river between its mouth and Mount Clemens, where the saw-mills, lumber-yards, and docks are located, and which obstructions have been described in former reports, 8 feet is the prevailing depth of water to be found in suitable width for convenient navigation. Hence the channel at the mouth of the river, which is exposed to heavy seas, should be made at least 10 feet deep; and this depth may now be recommended with greater assurance in connection with, and in view of, the channel protection hereinabove proposed, and the prospective comparative permanency of a new channel after it is completed. The sand dredged from the channel should be deposited behind the revetment and be leveled off even with the tops of the piles. To be sure the cost of dredging will be greater than if the sand was banked in the water on each side of the cut, but it is evident that when the material taken from the channel is removed to a place whence it cannot be washed back, a more permanent improvement will be the result.

The pile-crib which marks the outer terminus of the channel should be filled with cedar bark to the bottom of the cross-ties, and the balance of the space up to the top of the superstructure with stone or dredged material. The outer surface of the crib should be protected by a covering or sheathing, composed of 3-inch oak plank well spiked to the piles. This is especially necessary on the east and south sides of the crib, which are most exposed upon the breaking up of the ice in the spring of each year.

My estimate of the cost of a project for the improvement of the channel at the mouth of Clinton River is as follows:

(1) Pile-revetment, 3,280 feet long, at $3.50 per linear foot	$11,480
(2) Dredging channel 3,400 feet long, 100 feet wide, and 10 feet deep material to be deposited behind the revetment, 33,420 cubic yards, at 30 cents	10,026
(3) Filling and reinforcing pile-crib	300
	21,806

Accompanying this report I have the honor to forward herewith inclosed a specification, bill of material, and estimate of cost of pile-revetment; a list of steamers and vessels built, owned, and doing business on Clinton River; a schedule of entrances and clearances of vessels, with their tonnage, and a letter from Mr. William E. Hall, one of the prominent business men of Mount Clemens, giving an approximate idea of the amount of shipping done here annually.

With the same mail I also transmit on roll the following tracings:

(1) Map of survey with project of improvement.

(2) Sketch of northwest part of Lake Saint Clair showing channel at the mouth of Clinton River.

(3) Sketch of proposed pile-revetment.

I am, general, very respectfully, your obedient servant,

B. H. Muehle,
Assistant Engineer.

General O. M. Poe,
Lieutenant-Colonel of Engineers, U. S. A.

CLINTON RIVER, MICHIGAN.—SPECIFICATION OF PROPOSED PILE-REVETMENT.

Piles to be driven on established line, 3 feet 9 inches between centers, with a minimum penetration of 12 feet, and their tops cut off level at a height of 5 feet above standard low-water mark.

Cap-timber in lengths of 24 feet, bolted to each pile with 1-inch square wrought-iron drift-bolts 30 inches long, the contiguous ends of the timbers joined by a horizontal lap 18 inches long, with centers meeting on top of every seventh pile.

A sheathing composed of 3-inch plank, to be constructed as follows: Below water, in panels 22 feet long, with four upright cleats, 3 inches by 9 inches, secured with 5-inch ship-spike, each cleat projecting about 1 foot below the bottom plank, with sharpened end, and extending above the top course 6 feet. These panels to be set flush against the rear face of the row of piles, breaking joint with the lap-connection of the cap-timbers, the lower ends of the upright cleats to be driven into the sand bottom with a maul until the lower course of plank is grounded, the top edge horizontal and the contiguous ends of the panels rest perpendicularly against one of the piles. Above water, courses of 3-inch plank are then successively introduced between the piles and projecting cleats, each course breaking joint with the one below it, and spiked to the piles at each intersection with two 7-inch spikes, the contiguous ends of plank meeting opposite the center of a pile. Above water the rear faces of the piles should be chamfered down to form a flat-bearing surface in perpendicular line with the rear face with the cap-timbers. Finally, the projecting ends of the cleats are spiked to the sheathing.

In rear of this revetment cedar bark is piled up as follows: A row of stakes 12 feet long is first driven at a distance of 6 feet in the clear from the sheathing, one opposite each second pile in the revetment, or about 7.5 feet apart. In the space between the revetment and the stakes cedar bark is packed in alternate layers, diagonally crossing each other, as shown in the drawing. This is weighted down and anchored to the bottom either by a sufficient quantity of stone or by depositing thereon material dredged from the adjacent channel.

BILL OF MATERIALS FOR 1,000 LINEAR FEET OF REVETMENT.

267 piles, Norway pine, 1 foot diameter, midway between ends, and not less than 25 feet long.

45 pieces of cap-timber, pine, 12 inches by 12 inches by 24 feet.

13 courses of sheathing-plank, pine, 3 inches by 12 inches, of assorted lengths, 39,000 feet, B. M.

180 pieces pile-plank, cleats, 3 inches by 9 inches by 16 feet.

267 wrought-iron drift-bolts, 1 inch square by 30 inches long.

4,680 wrought-iron 5-inch ship-spike.

3,204 wrought-iron 7-inch ship-spike.

120 stakes, 4 to 6 inches diameter, 12 to 16 feet long.

375 cords of cedar bark.

ESTIMATE OF COST OF 1,000 LINEAR FEET OF REVETMENT.

267 piles, furnished and driven, at $3	$801 00
58,440 feet, B. M., timber and plank, furnished and put in place, at $25	1,461 00
4,238 pounds drift-bolts and spikes, at 5 cents	211 90
120 stakes, furnished and driven, at 50 cents	60 00
375 cords cedar bark, furnished and put in place according to plan, at $1.50	562 50
	3,096 40
Add 10 per cent. for contingencies	309 60
	3,406 00

Respectfully submitted.

B. M. Muehle,
Assistant Engineer.

List of steamboats and vessels built, owned, and doing business at Mount Clemens and Clinton River.

Description.	Name.	Tonnage.	Owned.	Built since 1881.	Doing business.
Steam-barge	Handy Boy	136	Entire	Yes	Yes.
Do	City of Mount Clemens No. 2	98	Entire	do	Do.
Do	Ida Burton	60	Entire		Do.
Do	Florence	60	Entire		Do.
Do	S. H. Johnson	121	⅛ int		Do.
Do	J. S. Ruby	112	⅜ int		Do.
Do	A. Weston	402	¼ int	Yes	
Do	Alleghany	380	⅛ int		
Do	R. H. McDonald	382		Yes	
Do	William Rudolph	221		do	
Do	City of Mount Clemens No. 1	110	Sold	do	
Steamer	Ida	68	¼ int		Do.
Steam-yacht	Euna		Entire		Do.
Do	Nellie Abar		Entire		Do.
Tow-barge	Jeanette	394	¼ int	Yes	
Do	Virginius	422	Entire	do	
Do	Nellie	156	Entire	do	Do.
Do	Fulton	342	¼ int		
Do	Evaline	364	¼ int		

One large tow-barge now building.

Entrances and clearances during the season 1884, *as reported by deputy collector of customs.*

Months.	Entered.	Cleared.	Tonnage.
April	11	17	2,086
May	24	22	1,930
June	23	23	1,974
July	23	22	2,784
August	20	18	2,168
September	15	19	1,711
October	13	12	1,114
November	12	7	701
December		1	58
Total	141	141	14,526

This list includes only foreign vessels and those from other districts, less than one-third of all the shipping at this port.

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PRELIMINARY EXAMINATION OF SAINT CLAIR RIVER AND SAINT CLAIR FLATS CANAL, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1884.

SIR: The river and harbor act of July 5, 1884, contains the following item, viz:

> Saint Clair River: Examination and survey of the right bank from Lake Huron to Lake Saint Clair, to ascertain whether the erosion and wearing away of said bank is injuring the navigation of Saint Clair River and Saint Clair Flats Canal, by shoaling the channel and obstructing navigation therein, and to report estimates of expense for preventing such injury.

By letter of July 31, 1884, from the office of the Chief of Engineers, this subject was referred to me for a preliminary examination, and to report whether in my opinion the "river is worthy of improvement."

The preliminary examination which I deemed requisite in order to arrive at an intelligent conclusion was intrusted to Assistant Engineer O. B. Wheeler, who has reported the result in considerable and quite sufficient detail.

As an abstract question there can be no doubt about Saint Clair River, Michigan, being "worthy of improvement," but it is quite another question as to how it is to be done.

As was to have been expected, Mr. Wheeler's figures show conclusively that the erosion of the right bank of the river is going on with more or less serious effects upon the lands and highways along it. But they also show that this erosion has but slight effect upon the channels, either of the river or of the canal, when compared with the greater effect produced by sediment brought from Lake Huron and from the river affluents of the Saint Clair.

Therefore, if it be proposed to improve the river by any system of bank protection it must be pronounced not worthy of improvement in the interests of navigation, however advantageous such improvement might be to the interests of the owners of the lands adjacent to the stream.

But the observations show that a sufficient amount of sediment is brought down by the river from all sources to produce, in course of time, serious obstructions to navigation. These are manifested on the bar at the North Channel, and at the lower end of the canal. At the latter locality the channel has been narrowed to such an extent that remedial measures are now required.

As compared with any other plan, that of removing the deposit by dredging is much the cheaper, and experience shows that once opened to the full width of the canal, the channel will remain so for some years; and this course I recommend, as I have already done in my annual report.

In the absence of any cotemporary survey it is impossible to submit an estimate of the amount of material to be removed that would be anything more than a guess, and I recommend that during the coming winter a survey be made on the ice at the lower end of the canal, and that an estimate of cost be based upon this survey. Such a survey, I estimate, would cost as follows:

1 assistant engineer, 1 month	$175 00
1 sub-inspector, 1 month	90 00
2 leadsmen, 1 month each, 60 days, at $2.50 per day	150 00
2 chainmen, 1 month each, 60 days, at $2.50 per day	150 00
4 axmen, 1 month each, 120 days, at $2 per day	240 00
Transportation, &c	100 00
10 per cent. for contingencies	90 50
Total	995 50

It may be that this should properly be borne by the appropriation for "operating and care of canals and other works of navigation," as it really is part of the canal improvement.

I do not recommend any survey at the North Channel at present, and therefore do not submit an estimate for one.

Respectfully submitted.

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. O. B. WHEELER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 7, 1884.

SIR: I have the honor to report the following results of a preliminary examination made under the following orders from you, bearing date Detroit, Mich., September 29, 1884:

"SIR: You will please proceed to Port Huron, Michigan, and from thence make a rapid reconnaissance of the right bank of Saint Clair River to Lake Saint Clair, for the purpose of collecting data for a preliminary report upon the question, whether 'the erosion and wearing away of said bank is injuring the navigation of Saint Clair River and Saint Clair Flats Ship-Canal by shoaling the channel and obstructing navigation therein?'

"The information obtained by you should only be sufficiently in detail to enable you to make an approximate estimate of the extent of the erosion, the causes thereof, and whether the injury to navigation is of sufficient extent and of so serious a character as to warrant a resort to remedial measures on the part of the General Government.

"If, in your opinion, such remedial measures should be undertaken, your report should be accompanied by an estimate of the cost of the necessary detailed examination and survey." * * *

On October 1 I proceeded to Port Huron by steamer, taking note of the clearness of water in the Detroit River, Lake Saint Clair, the Saint Clair Flats Ship-Canal, and Saint Clair River, and noting the contrast between the channel water and that close inshore as the steamer coasted along the right bank of the Saint Clair River. On the 2d, severe rains having occurred during the night and the day being rainy, I took the opportunity of examining the bank under such conditions, again by the river steamer, going as far as Algonac and returning, and taking notes on every mile of bank. From the 3d to the 8th I examined by land the 30 miles of bank between Gratiot light-house and Point aux Chenes, 1 mile below Algonac, taking note of the wash, the attempts made to protect it, and getting information from the most reliable inhabitants in regard to the rate or amount of erosion, and on the 8th made a study of the effects of a very severe wind and rain storm on the roads and bank. From the 9th to the 13th I made a study of the roil occasioned by the storm of the 8th as, coming from Lake Huron, it took possession of the river, the flats, and a portion of Lake Saint Clair. As a basis for this examination tracings from the United States Lake Survey detail charts, survey of 1867-'68, were furnished by the Engineer Department.

The bed of the river is in blue clay, the stratum being from 100 to 200 feet in thickness to the bed-rock, as shown by the numerous wells bored along the banks. There is, in places, much sand and silt where an old channel has been refilled, as on the site of the depot grounds just south of the mouth of Black River, where the borings are through 36 feet of sand before reaching the blue-clay bed.

The channel has a very direct course for 30 miles, the most severe bend being against the Canadian shore at Sarnia. It is from 30 to 60 feet deep to the head of the south channel, and continues about the same through this channel to the ship-canal, but in the north channel it is from 42 to 90 feet in the depth to the bar at its mouth. The north and south channels have about the same width, but the north is much shorter, and its waters find the general lake level of Lake Saint Clair at a shorter distance than those of the south channel. As an evidence that the north is not more obstructed in the discharge of its waters than the south, I would cite the fact that through a small channel below Russell's Island the water flows from the south channel into the north. The stronger current of the north channel is perceptible when crossing from the south channel to Algonac. There is no doubt then but that the north channel has the stronger current, and carries the greater portion of the water of the Saint Clair River. On older maps the north channel is represented as being the main river.

The right bank is generally of blue clay at the water-line, and for a few feet above. Generally above this yellow sand or yellow clay is found, and above the yellow clay gravelly or sandy knolls or ridges. The yellow clay in places carries small stones and bowlders; in other places it is of fine brick quality. The height of bank is from a marshy water-line to a bank of 20 feet. From a study of the contour lines of charts, together with my own observations, I have formed the following estimate of heights of bank for 30 miles of river:

	Miles.
From 0 feet to 5 feet height of bank	12
From 5 feet to 10 feet height of bank	10
From 10 feet to 15 feet height of bank	7
From 15 feet to 20 feet height of bank	3

Or the estimated mean height would be 8 feet. The higher banks are on the upper portion of the river.

By river steamer I observed that the erosion was going on at intervals throughout the whole distance; that the roil was very thick close inshore for more than one-half the distance. It was possible to see the earth fall when disturbed by the waves of the steamer which ran very close to shore, and made numerous landings. The number of estimated passages of these coasting steamers is, during the six months of the season of navigation, from twelve to fourteen daily. Numerous barges with tow seek in going up the close inshore to avoid the heavy current of mid-channel. The wake waves dash several feet in height against a nearly vertical bank, which they undermine. Attempts to protect are noticed along at least one-third of the bank.

By road I found that the highway had been washed away in many places. In places it had been rebuilt, in other places set back its width two or three times, and in others abandoned and located further inland. The abandoned road was in some cases around marshy places where it would have been difficult to maintain a road along the beach. The rebuilt road was in low places, and generally where a small stream entered the river, and in extent not more than 20 rods in any one place. In the township of East China, between Saint Clair and Marine City, there is about 2 miles of nearly continuous erosion on a bank of 8 to 15 feet high, going on at a rate of 2 to 3 feet per year. The highway has been set back twice, and there is now but 7 feet between the fence and a vertical bank at one point of the road, and for a quarter of a mile there is scarce room for two teams to pass.

In quantity of surface the erosion has been greatest on a 3 to 5 foot bank just above and below Marine City, where I was shown that the wash had been about 10 rods in forty years. In one case the road and three apple trees had been washed out since the early settlement. Opposite Stag Island on a 15 to 20 foot bank I found two large trees, a pine and an oak, lying with tops in the current, having just slid down the bank. Other branches of small trees were visible above the muddy water out to 50 feet from shore. These native trees have, with their roots, acted as a protection to the bank, and still act in places, the greatest erosion occurring where the banks have been cleared and roads or cultivation brought too near the bank. The lower banks were originally covered with a dense undergrowth, upon which when cleared and plowing brought near the banks the destructive results of surface water from the sloping ground are evident. So, also, along the highways, as witnessed by myself on the 8th, the water from the fields follows the wagon track and leaves it at intervals, with destructive results to the banks and roads. The highways, for the great part, are not properly worked. There should be ditches with proper sluices for leading this water across the road.

Wherever the remains of an old lumber-mill or dock are found, there the bank of many years ago still remains, but it is cut away immediately above and at a greater distance below. When a stump or log has lodged along shore there is found a portion of bank standing out towards it, and where there has been a large amount of gravel or stone in the capping stratum there is formed a sort of riprap which protects well at the water-line.

The stage of water this season and last has been unusually high, so the water-line has been above the sandy or gravelly beach, and the waves have acted more directly upon the clay.

Up to the 8th I had not seen the roil extending more than 200 feet from shore, and in the morning the roil of the previous day had generally settled. On the 8th, under a heavy rain and a northeastern gale, the bank was greatly washed, and the roil at East China extended, at dusk, about 20 rods from shore.

The present protection, for most part, must be considered of a very temporary nature. Logs, stumps, brush, and sawdust are thrown in along shore. In some cases the brush is piled with system. Slabs cut 4 feet long and corded upon stringers along the bank, and again loaded down and bound with stringers, form a few years' protection in places. A little stone riprap is found.

A boom of logs above Marysville protects temporarily 2 miles of bank. The most recent and expensive protection has been of piles with stringers and close sheet-piling, back-dredging being done about 8 feet in front, and the earth thrown back over the piling to form a bank. This may be quite permanent, but generally there is too much timber to rot above the water-line.

In considering the extent of erosion I omit these attempts at protection and estimate the bank as being eroded for 18 miles of the 28 miles of main river, at a rate of 1 foot per year on a bank of 8 feet in height. This would give an annual erosion above water of eight twenty-sevenths of a cubic yard for every foot of distance, or 28,160 cubic yards for the 18 miles. It is a known fact that the channel of a river is eroded more upon the west side than upon the east. It is believed that the channel of this river is following up the caving of the banks.

If we estimate that the 30-foot channel is approaching the banks at one-half the rate of the bank erosion, knowing, as is approximately shown by the charts, that the 30-foot channel is now at an average distance of about 300 feet from shore, we shall have approximately a section a tenth of a foot in thickness and 300 feet wide for every foot of horizontal erosion at the bottom of the channel, or an annual amount of 52,800 cubic yards for the erosion under water. This would be an erosion of about one-twentieth of a foot (or three-fifths of an inch) in thickness per year on the inclined bed, and does not seem to me to be too great an estimate. It is, however, in quantity nearly double that above water. The left (or Canadian) bank of the river is also undergoing erosion, as was observed by myself and as I was told by others living upon that bank. Mr. James Danson, ex-member of Parliament, estimates that four-fifths of that bank is undergoing erosion, principally from the action of waves caused by the prevailing west wind.

The Ontario Government has been urged to protect the highways upon the banks on the ground that the Government owns the banks.

The river in consequence of erosion is widening and must be becoming of less depth. There is very little deposit of sediment along the banks, but there may be more upon the middle ground, which seems to be growing in extent. The middle ground has been used as a place of deposit for dredgings of harbors.

In studying the roil from the storm of the 8th, I found at evening that the roil from the banks extended less than 400 feet from shore, while the main portion of the river remained clear as usual. At daylight the next morning at Saint Clair the whole river was seen to be deeply colored with roil. The morning of the 9th was very calm, the storm being entirely over. At 9 a. m. I took a steamer for the Saint Clair, Flats, hoping to get ahead of the roil, but the inspector at the canal and the fishermen told me that it was at the canal at daylight. The fishermen understood this roil to come directly from Lake Huron, and that there would be no good fishing for two or three days, or until this roil had cleared from the lower end of Lake Huron. On the 10th I crossed over by row-boat from the canal to the mouth of the north channel. The roil was everywhere about uniformly distributed except in a bay below Dickinson's Island, where it was clearer from the effects of a stream coming in from the island. The effects of bars at the mouths of channels, in forcing the water to leave the channels at all points through the grass and rushes and thus distribute the sediment on all parts of the flats, was very evident.

On the 11th, at 4 p. m., I took from the south channel in clear glass quart-bottles, two samples for examination. The one was from a depth of 40 feet, where the channel was 45 feet deep; the other from near shore, and from only 1 foot below the surface. There was no difference in the appearance of the two, each having the same milky white appearance. Earlier the roil had been more dense and of a yellower cast. The one from a 40-foot depth I have evaporated down after letting the sediment settle well, and with a siphon drawing off two-thirds of the water. The result is a light colored clay, which adheres very firmly to the glass, in weight 1⅔ grains, as determined by an analytical chemist. The quantity of water flowing through the Saint Clair River, as determined by the United States Lake Survey, is 233,726 cubic feet per second. (See the Chief of Engineers' Report for 1868, page 959.) This is a little more than 7,000,000 quarts per second. One and two-thirds grains multiplied by 7,000,000, gives five-sixths of a ton for the sediment per second, and 72,000 tons for a day. The roil continued more than four days, and had a greater intensity during the first two days than at the time the samples were taken. If, then, we take three days at 72,000 tons per day we do not overestimate, and we have 216,000 tons or 148,000 cubic yards, allowing 18½ cubic feet for clay, to the ton, for three days. The sediment then from a single storm on the lower end of Lake Huron is greater than that from the right bank of the Saint Clair River in a year, and this entire sediment of Lake Huron, as computed, is deposited in the still waters of the flats and Lake Saint Clair. A thin roil at noon on the 13th was found to extend about 6 miles below the lower end of the ship-canal, but it is not probable that any great amount of the sediment found its way to the center of Lake Saint Clair. In Appendix G, page 281, of the Report of the Mississippi River Commission for 1883, it is shown that in the Mississippi River "the bends have moved down-stream; the islands have moved down-stream; the preponderance of the movement of the river has been to the west."

An island is known by the older inhabitants to have existed opposite Saint Clair City, and to have been cut away principally by ice, and now there remains an extensive middle ground. We may hold that this island has "moved down-stream," and at least a portion of it found its way to the ship-canal.

CONCLUSIONS.

I find that the right bank of the river is being eroded at a rate of over 75,000 cubic yards per year, but believe that only a very small per cent. of this is carried across the swifter north channel to impair navigation in the south channel, or in the ship-canal; that the left bank is also being eroded. The heavier material no doubt remains along the river, and the tendency is to both widen the river and make it more shallow. I find that double the above amount of sediment was probably brought down directly from Lake Huron as a result of a single storm, and that the probable amount of sediment brought down by freshets in the Black, Pine, and Belle rivers is greater than that from the right-bank erosion. This sediment, taken up by the lashing waves of the lake and rushing currents of the rivers, is more firmly held by the water and deposited where the injury to navigation would be greater than that from the right-bank erosion. It is certain that the northwestern portion of Lake Saint Clair, including the mouth of the ship-canal, is being obstructed by sedimentary deposit, but it is believed that the sources of obstruction are so many that the protection of any one source would not relieve the necessity for the dredging of the channels, and that the interest of the cost of thoroughly protecting the right bank of the Saint Clair River would more than pay the expenses of dredging from the channels that portion of the deposit due to the right-bank erosion. The protection which would at once nearly stop the erosion must be such as to redeem a large part of the shoal-water ground, and the system of dikes or wing-dams with riprap on the banks between would, I believe, be the most effectual.

In my opinion, protecting the right bank of the Saint Clair River from erosion, on the ground that the sediment therefrom is injuring the navigation of Saint Clair River and Saint Clair Flats Canal, is unworthy of improvement by the General Government.

Very respectfully, your obedient servant,

O. B. WHEELER,
Assistant Engineer.

General O. M. POE,
Lieut. Col., Corps of Engineers, U. S. A.

REPORT RESPECTING SURVEY OF SAINT CLAIR RIVER AND SAINT CLAIR FLATS CANAL, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., January 30, 1885.

SIR: The examination and survey at the Saint Clair Flats Ship-Canal ordered by your instructions of November 21, 1884, have been prosecuted as well as the weather would permit, but will not be completed in time to admit of an extended report to reach your office by the 1st February, the date fixed as the limit. Still, enough has been done to produce immediate results, sufficiently in detail to exhibit facts of a remarkable character.

A comparison between the accompanying tracing of the survey of January, 1885, and "blue print" of the survey of January, 1883, shows:

(1) That the channel at the lower approach to the canal remains practically the same as at the time of the survey in January, 1883.

(2) That therefore no considerable portion of the material brought down the river by the current within the last two years has been deposited in this channel.

(3) The two surveys (January, 1883 and 1885) being ice surveys, could be and were made practically identical, and for a depth of 16½ feet and width of 300 feet the difference between the estimates based upon the two surveys is less than 60 cubic yards in about 28,000, or a quantity entirely within the limits of probable error.

As it is contemplated to make the lower approach to the canal a little wider than the canal itself, the estimate heretofore submitted of the amount of material to be removed from this part need not be modified.

It was for dredging 40,000 cubic yards, at 25 cents, $10,000.

For lack of data at this date it is not possible to discuss the question so far as it relates to deposits in the canal and at its upper approach, but it will be included in a report to be submitted hereafter.

It is sufficient at this time to say that the necessity for any work of dredging in the canal, or at its upper approach, does not seem to be so pressing as at the lower approach.

Very respectfully, your obedient servant,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF SAINT CLAIR RIVER AND SAINT CLAIR FLATS CANAL, MICHIGAN.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., *March* 6, 1885.

SIR: Under date of the 13th November, 1884, I had the honor of submitting a preliminary report upon "Saint Clair River; examination and survey of the right bank from Lake Huron to Lake Saint Clair, to ascertain whether the erosion and wearing away of said bank is injuring the navigation of Saint Clair River and Saint Clair Flats Canal, by shoaling the channel and obstructing navigation therein, and to report estimates of expense for preventing such injury," and expressed the opinion that as an abstract question there could be no doubt about Saint Clair River, Michigan, being "worthy of improvement," I also stated that the obstruction to the channels caused by the erosion of the right bank of the river was comparatively insignificant, and that any attempt to improve the navigability of the channel by a system of bank protection was "not worthy of improvement."

I recommended a winter survey at the canal, for the purpose of determining, if possible, the rate of deposition of eroded or transported material, and this was approved by letter from the office of the Chief of Engineers, dated November 21, 1884. It was not until after the middle of January, 1885, that the ice was in suitable condition for a proper survey.

The surveying party, under charge of Assistant Engineer B. H. Muehle, reached the canal on the 21st, and immediately entered upon the work, completing it on the 31st. A copy of Mr. Muehle's report, dated February 27, 1885, is hereto appended. The report of Mr. Muehle, taken in connection with that of Mr. O. B. Wheeler, transmitted with my preliminary report of November 13, 1884, seems to exhaust the subject, as far as concerns the effect produced upon the navigation of the canal by the erosion of the right bank of the Saint Clair River.

The special report transmitted by me under date of January 30, 1885, deals with the condition of the channel at and below the lower end of the canal, and requires no modification.

To the estimate therein made it is only necessary to add the cost of the dredging required at the upper end of the canal to fully restore the channel. The quantity to be removed is in the neighborhood of 8,000 cubic yards.

The estimate then becomes:

For dredging at the lower end of the canal, 40,000 cubic yards, at 25 cents...	$10,000
For dredging at the upper end of the canal, 8,000 cubic yards, at 25 cents...	2,000
Add 10 per cent. for contingencies..........	1,200
Total..........	13,200

It seems to be beyond question that the cheapest way to preserve the channel across Saint Clair Flats is to maintain the present canal and to remove, by dredging from time to time, the accumulations above and below it.

The cost would be but a small proportion of what would be required to protect the right bank of Saint Clair River, and such protection would only be remedial in a comparatively small degree, for we would still have the much greater accumulations due to the sediment from Lake Huron, and the erosion from the Canadian side of the river to take care of and remove.

In case it be deemed best to print this report, I have to request that it be considered as including all the papers on the subject, beginning with my report of November 13, 1884, and ending with this.

Very respectfully,

O. M. POE,
Lieut. Col. of Engineers,
Bvt. Brig. Gen., U. S. A.

To the CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. B. H. MUEHLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., February 27, 1885.

GENERAL: On the 26th day of December, 1884, I received your instructions to "proceed to Saint Clair Flats Canal," there to "make a survey showing the condition of that improvement, especially of the channel from the lower end into Lake Saint Clair," and, if possible within the limit of available funds, "to include the whole canal and the approach at the head."

In obedience to these instructions, I proceeded, on the 21st day of January, 1885, via Algonac, to the head of the Saint Clair Flats Canal, and took quarters at the upper light-house. Commencing operations at a point 7,000 feet south of the head, and near the lower end of the canal, soundings were taken through holes cut in the ice for the purpose, on lines at right angles to the inner face of the west dike, 25 feet apart, and on each line every 20 feet, in such manner that each point of sounding on one line was located opposite the center of the space between two soundings on the next adjoining lines. On this plan an area extending from the starting point out into Lake Saint Clair, a distance of 2,000 feet, and 300 feet wide, was sounded, which covered the shoalest part of the channel entrance. From thence the lines of soundings were run 50 feet apart, and the points on each line 20 feet apart for a distance of 1,000 feet, and 50 feet apart for a further distance of 750 feet along the axis of the channel, where the deep water of the lake was reached and sounding discontinued. On each side of the 300-foot channel, which is equal to the width of the canal, the lines of soundings were extended every 50 feet, so as to widen the area examined to 500 feet, or 250 feet on each side of the axis of the canal as extended into Lake Saint Cair.

The soundings thus far taken were reduced to standard low water and platted, and a tracing of this portion of the survey. together with an estimate of quantities of material required to be removed by dredging to afford a uniform channel depth of 16 feet, was forwarded to you under date January 28, 1885.

The funds available being far from exhausted, the sounding of the channel between the canal dikes was continued from the starting point to the head of the canal, on the plan first above described, and extended 750 feet beyond the head or until deep water was reached, at the junction with the old south channel of Saint Clair River.

The field work was completed January 31, 1885, about 6,500 soundings in all having been taken, and after discharging the party I returned to Detroit on that day.

This survey was made in connection with an examination and survey of the right bank of Saint Clair River, from Lake Huron to Lake Saint Clair, required by the river and harbor act of July 5, 1884, and with special reference to the question whether "the erosion and wearing of said bank is injuring the navigation of the * * * Saint Clair Flats Ship-Canal by shoaling the channel and obstructing navigation therein."

In order to determine whether, and, if any, how great, a change has taken place in the level of the channel bottom during a given period, the soundings were taken as nearly as possible on the same lines and places which were sounded in January, 1883, under the direction of Maj. F. U. Farquhar, Corps of Engineers, U. S. Army, (a map of which survey is on file in your office). Thus a close comparison of the depths of water given as the results of the two surveys is afforded and the changes which have taken place in the channel bed during the past two years may be described as follows:

1. The channel entrance at the head of the canal is obstructed by two shoals, one extending from the head of each of the dikes in a northerly or up-stream direction, and the bottoms of the slopes of which shoals encroach upon the channel of 16 feet depth in a manner to contract the width of such navigable channel to only 100 feet at a distance of about 300 feet above the heads of the canal banks. This contraction of the channel entrance was found in 1883, and appears to have changed but little within

the last two years, as shown by the accompanying sketch.* While the width remains substantially the same, the depth of this reach has increased quite perceptibly, as is indicated by the changed position of the 17-foot curve of the old south channel at its intersection with the channel of entrance to the canal. The shoal which projects from the head of the west dike of the canal has retained the same proportions during the last two years, while the easterly shoal shows accretions upon its northerly end, which, however, do not encroach upon the navigable channel along the axis of the canal entrance.

The cubic contents of the two shoals, as shown by the surveys of 1883 and 1885, respectively, including an area bounded by parallel lines, which are continuations of the inner faces of the canal banks, have been computed and illustrate the changes which have taken place within the last two years, as follows:

Shoal.	1883.	1885.	Increase.
	Cub. yds.	*Cub. yds.*	*Cub. yds.*
East Shoal	4,146	5,520	1,374
West Shoal	1,885	1,917	32

The peculiar shape of the portion of the river bottom which includes the *accretion* during the past two years should be noted. It consists of a succession of sand waves with their crests at right angles to the axis of the channel, sloping gradually and uniformly upwardly toward the canal entrance and dropping abruptly on the downstream side at intervals of 40 to 50 feet. This formation of the bottom has been frequently observed while sounding in summer time from a boat floating with the current, and is clearly illustrated in the appended sketch* showing the result of the survey just completed. During the last few years it has been discovered that a new channel has cut through the marsh from the east shore of the south channel in a southerly direction immediately behind the east shoal and east dike of the canal. While, therefore, it appears probable that the gradual increase in the length of this shoal up-stream is due to the effect of seas running from the lake through this new channel during southerly gales, which, when meeting the river current, deposit sand carried in suspension in the form indicated, yet this does not preclude the possibility that a portion, if not all, of the accretion may have been brought down with the current from the upper reaches of the river. In 1873–'74 the channel was deepened to 16 feet, dredging a width of 200 feet, 100 feet each side of the axis of the canal, and the encroachment of these shoals upon the improved channel are therefore only about 50 feet at the narrowest portion; hence, the obstruction to navigation at this point is but trifling and may readily be removed by dredging. The restoration of the 200-foot channel will involve but a nominal expenditure, and the cost of removal of both shoals to a depth of 16 feet of water, between parallel lines 300 feet apart, as shown, may be estimated at less than $2,000.

2. The area bounded by the two dikes forming the canal, which is 7,221 feet long by 300 feet wide, includes a central channel of 16 feet depth and 200 feet wide, and on each side a sloping bank 50 feet wide which represents the remains of the original 13-foot channel made at the time the canal was built. The survey of 1883 clearly shows that the 16-foot channel during the ten years of its existence remained in a remarkably good condition, excepting a slight caving in of the banks, more especially on the west side, and there appears to be no important change in the channel bottom during the last two years. Both surveys show a greater depth of water than 16 feet in the upper reach, and a corresponding amount of shoaling near the lower end of the canal. It is believed that the disturbance of the channel banks is caused principally by the action of the waves or swells produced by passing steam vessels, and this theory is doubtless correct, for it will be observed upon examination of the soundings taken, that in close proximity to nearly every shoal spot or area a corresponding hole or depression in the canal bottom may be traced, and this formation be ascribed to the action of the screws of vessels of heavy draught.

The crests of these swells often rise to the height of the dikes of the canal, and, with other causes, have drawn the sand through the revetment. This withdrawal of the filling of the dikes has been observed for several years, and the cavities caused thereby have been refilled with cedar bark and marsh-sod. Estimating the amount of sand drawn into the canal by the quantity of filling used to replace it in the bank, there must have been 6,875 cubic yards of sand added to the slopes of the channel during the seasons preceding the year 1881 alone; and as there are cavities of almost equal number and size along the inner face of the dikes at the present time, a proportionate quantity of sand has doubtless been added since. Nevertheless, the recent survey does not show that this sand was deposited in the central channel in a manner to obstruct navigation therein, and it may be assumed that it was held in suspension by the swells of passing steamers, and gradually carried down-stream, by the natural current in the canal, to a place of deposit at or beyond the lower ends of the dikes. Hence, while the channel depth between the canal banks appears not to have been reduced by the sand washed through the revetment of the dikes—on the contrary, showing a perceptible increase within the last two years—it is reasonable to conclude that the navigation of the canal between its banks is not, and never will be, seriously obstructed by sand, which might be carried down-stream by the current from the right bank along the upper reaches of the Saint Clair River or through said river from the shores of Lake Huron.

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* Sketch omitted.

3. The channel of entrance at the mouth of the canal, extending from the lower ends of the dikes to the deep-water of Lake Saint Clair, a distance of about 3,200 feet, has, within the last few years, shoaled up to a considerable extent. In 1880 the original depth of the 16-foot channel was restored by dredging, furnishing temporary relief. Both the surveys of 1883 and 1885 show that the channel has again filled up with sand-bars in a manner to practically restrict navigation to 15 feet. In order to determine whether these obstructions were caused by the littoral current along the marshy shores of the lake or brought down-stream through the canal from the headwaters of the Saint Clair River, an examination was made of all the surveys and maps of the canal and vicinity on file in this office to discover the amount of shoaling which has taken place from time to time, and its location relative to the channel entrance. Thus it was found that the 13 foot curve in Lake Saint Clair has, ever since the canal was built, steadily moved lakeward from the ends of the dikes in the proportion shown by the following table:

On line of—	East dike.	West dike.	Average.
	Feet.	*Feet.*	*Feet.*
1870, completion of canal	920	800	860
1872, survey of November	1,180	1,120	1,150
1873, before dredging 16-foot channel	1,232	1,216	1,224
1883, survey, January	1,775	1,625	1,700
1885, survey, January	1,800	1,600	1,700

Within the limits of the areas sounded in 1883 and 1885 it is impossible to give the extent of the shoals in a direction at right angles to the axis, both east and west of the channel; but the figures given above indicate that bars have formed on each side of the channel entrance, which accretions have grown and expanded on the lines of the dikes on an average distance of about 840 feet in fifteen years.

Comparing these deposits at the mouth of the canal with the shoals which have formed at the outlets of the various other channels comprising the Saint Clair River delta, a great similarity is apparent; and it is fair to assume that the artificial outlet formed by the Saint Clair Flats Canal has carried, and does carry, its proportionate share of sand in suspension which may be brought down by the river current from the headwaters of the Saint Clair or from Lake Huron.

But the results of this survey, as well as that of 1883, tend to prove that the 16-foot channel dredged in 1873–'74 has not been seriously obstructed by the growth of these sand-bars, and that a good and straight channel of 15 feet depth and nearly 200 feet wide has been, and still is, available for safe navigation. The obstructions shown extend from the ends of the dikes a distance of about 1,700 feet into the lake. Beyond that point there is a 16-foot channel, varying in width from 150 to 200 feet. It is believed that this channel is kept open in consequence of its almost constant use by steam-vessels and tow-barges moving in both directions between the deep water of the lake and the canal entrance; and when the difficulty is taken into consideration which is encountered by all vessels, but more especially steamboats with a number of barges in tow, while trying to enter the canal in foggy weather, or with a beam wind or under a gale, it is surprising that the channel remains in such fair condition. The shoal areas close to the mouth of the canal were probably caused by vessels entering under difficulties, as described, meeting others in this narrow cut running in an opposite direction, and which, while trying to avoid collisions, come in contact with the banks of the channel in a manner to transfer quantities of sand from the slopes to the channel-bed.

The effects of the blockade occurring in the latter part of October, 1884, in this locality, and which lasted several days, during which time a number of large vessels were aground upon the banks of and the shoals in the channel, may readily be traced upon the map of the survey.

A number of holes in the river bottom are shown where the vessels were stranded, with adjoining mounds of sand evidently thrown up by the wheels of the powerful tugs and steamers in the efforts to extricate the vessels from their perilous position. This theory is borne out by the fact, which is fully established by the surveys of 1883 and 1885, that the cubic contents of these shoals within parallel lines 300 feet apart are shown by computation to be essentially the same, being estimated at 27,980 cubic yards in 1883, and 27,923 cubic yards in 1885.

The conclusions which may be drawn from the foregoing statement of the result of the examination and survey are briefly summed up as follows:

(1) That a portion of sand and sediment which is carried in suspension by the current from the right bank to the Saint Clair River and Lake Huron finds its way through the canal and is deposited in Lake Saint Clair.

(2) That, nevertheless, the dredged channel above, through and below the canal is not obstructed by this movement of sand and sediment in a manner to seriously interfere with safe navigation.

(3) That this channel is kept open by the action of the agitation produced by steam craft and other vessels almost constantly passing through the canal during the season of navigation.

(4) That the shoals found in the narrow channel entrance at the mouth of the canal are caused principally by vessels passing each other, and compelled to run close to the banks of the cut to prevent collision; also by vessels entering the canal in foggy or stormy weather and unable to keep in the axis of the channel, and, incidentally, by vessels getting aground owing to such difficulty in entering the canal, and consequent blockade of the channel.

(5) That the remedy for these obstructions to the safe navigation of the channel entrance lies in dredging the same a width of at least 300 feet, or in an extension lakeward of the canal dikes, or both.

Very respectfully, your obedient servant,

B. H. Muehle,
Assistant Engineer.

General O. M. Poe,
Lieut. Col. of Engineers, U. S. A.

APPENDIX M M.

IMPROVEMENT OF HARBORS ON LAKE ERIE WEST OF BUFFALO, WITH THE EXCEPTION OF THE HARBOR AT ERIE—IMPROVEMENT OF SANDUSKY RIVER.

REPORT OF MAJOR L. COOPER OVERMAN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Monroe Harbor, Michigan.
2. Toledo Harbor, Ohio.
3. Port Clinton Harbor, Ohio.
4. Sandusky City Harbor, Ohio.
5. Sandusky River, Ohio.
6. Huron Harbor, Ohio.
7. Vermillion Harbor, Ohio.
8. Mouth of Black River, Ohio.
9. Rocky River, Ohio.
10. Cleveland Harbor, Ohio.
11. Fairport Harbor, Ohio.
12. Ashtabula Harbor, Ohio.
13. Conneaut Harbor, Ohio.
14. Dunkirk Harbor, New York.

EXAMINATION.

15. At Cleveland, Ohio, for opening and improving the channel known as the old "river bed" of the Cuyahoga River.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, July 25, 1885.

GENERAL: I have the honor to transmit herewith the annual reports of the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

L. COOPER OVERMAN,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

M M 1.

IMPROVEMENT OF MONROE HARBOR, MICHIGAN.

The harbor of Monroe, Mich., is situated at the extreme westerly bend of Lake Erie, about 1½ miles west of the old mouth of the Raisin River, and about 3½ miles from the town of Monroe.

This improvement was commenced in the year 1835, at which time the Raisin River was considered an important stream, and Monroe was a place of some prominence. The plan of improvement consisted in straightening the river and making direct connection with Lake Erie by a canal 4,000 feet long and 100 feet wide, through a sand peninsula. A description in detail of the operations heretofore carried on for the improvement of this harbor will be found in Annual Report of 1880 and 1881.

OPERATIONS DURING THE FISCAL YEAR.

No work in progress during the year, as there were no funds.

The whole amount appropriated for this harbor to date has been $213,515.27, all of which has been expended.

PRESENT CONDITION OF THE HARBOR AND PROPOSED PROJECT OF IMPROVEMENT.

An examination of this harbor was made in August, 1883, extending from the docks at Monroe to the 14-foot curve in the lake. The soundings showed but slight changes in depth of channel from lake to Monroe, but the bar in lake beyond end of south pier had increased somewhat, leaving a least depth of 8¼ feet for a short distance.

The following depths were found in August, 1883:

	Feet.
Least depth of water in channel entering the harbor	10½
Least depth of water in United States canal	11
Least depth of water in channel from United States canal to city canal	10
Least depth of water through the city canal	13
Least depth of water in channel from city canal to docks	10
Least depth of water in channel in front of lower docks	10
Least depth of water in channel in front of upper docks	8

The piers and revetment of canal are generally in bad condition, and portions of the piers below ordinary low water are badly rotted. General and thorough repairs will cost, according to previous estimates, about $20,000, but such an expenditure is not deemed necessary at present, as the commerce seeking this harbor is insignificant.

A small annual expenditure, say $1,000, will, in my opinion, keep the piers and revetment standing until commercial interests in the future shall require more extensive repairs; but as there has been no annual repairs since 1883, an estimate of $4,000 is made for same for fiscal year ending June 30, 1887.

The harbor of Monroe is in the collection district of Detroit, Mich. There is a fixed white light of the fourth order on the outer end of the west pier. The nearest work of defense is Fort Wayne, 30 miles distant. The amount of revenue collected during the eleven months ending May 31, 1885, was $61.61. The value of the imports was $17,409.

There were no exports.

Twenty-six vessels, with an aggregate tonnage of 4,219 tons entered, and twenty-five vessels, with an aggregate tonnage of 3,918 tons cleared, during the eleven months ending May 31, 1885.

The last river and harbor bill (act of July 5, 1884) made no appropriation of funds for this harbor; hence no repairs can be made during the fiscal year ending June 30, 1886, and this delay will increase the amount to be done over the proposed annual expenditure.

Money statement.

Amount (estimated) required for completion of existing project	$20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	4,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

M M 2.

IMPROVEMENT OF TOLEDO HARBOR, OHIO.

The city of Toledo, Ohio, is situated at the mouth of the Maumee River. The Maumee River empties into Maumee Bay at a point by way of the channel about 7 miles from the deep water of Lake Erie.

A history of the operations carried on in past years for the improvement of this harbor will be found in the Annual Reports for 1880, 1881, and 1883.

The present channel, which is 250 to 300 feet wide at the angles, with a depth of from 15 to 17 feet at ordinary low water, has been obtained by sixteen appropriations, averaging $43,670, and an annual average expenditure of about $41,320. It is probable that similarly large appropriations will have to be made for some years to come, and a continued annual expenditure of about $20,000 to keep the depth at present required, which depth will doubtless have to be increased from period to period by the demands of commerce.

The present project, adopted in 1872 and amended in 1880, so as to gain increased depth, provides for widening to 250 feet at surface and to 200 feet at bottom and deepening to 16 feet at low water the natural channel through Maumee Bay.

OPERATIONS DURING THE FISCAL YEAR.

At the beginning of the fiscal year $7,643.09 was available, and the act of July 5, 1884, appropriated $20,000 for this harbor. No work was in progress, nor were any contracts in force. As early as practicable contracts were made for dredging the natural channel to the extent of the available funds. Two contracts were entered into; one with E. H. French, of Fulton, N. Y., dated September 4, 1884, for the removal of 100,000 cubic yards, more or less, of mud, clay, sand, &c., at 15¾ cents per cubic yard, scow measurement; the second, dated September 5, 1884, with W. E. Rooney, of Toledo, Ohio, for the removal of 65,000 cubic yards, at 14¾ cents per cubic yard, scow measurement.

Operations were commenced at once and continued until November 22, when the unfavorable weather necessitated suspension until spring. Operations were resumed April 20, 1885, and continued until contracts were closed. Work under W. E. Rooney's contract was completed May 18, 1885, and a total of 65,068 cubic yards were removed. Work under E. H. French's contract was suspended June 9, 1885, for want of funds; a total of 90,017 cubic yards were removed. The progress made under both contracts was good, and the dredging was well done. The dredges under these two contracts worked over all the six ranges with the object of deepening the channel, as it was not practicable to deepen and *widen* all the ranges with the funds available.

At the close of the season of 1885 the condition of the channel was as follows:

First. From the Toledo City docks to the Manhattan Range a good wide channel, with a least depth of 18 feet.

Second. The Middle Range, 5,760 feet long, had a width from 170 to 180 feet, and least depth of 16.6 feet in dredged channel.

Third. The Phenstock Range, 5,055 feet long, had a width of from 192 to 240 feet (the latter width at the turns), and least depth of 16.3 feet in channel.

Fourth. The Carr Range, 11,580 feet long, with width from 120 to 210 feet (at turns), and least depth of 16.3 feet in dredged channel.

Fifth. The Turtle Island Range, 9,790 feet long and a width of from

60 feet across bars to 180 feet, and least depth of 16.25 feet in the dredged channel.

Sixth. The Outer Range, 7,800 feet long and a width of from 60 feet to 210 feet, with least depth of 16.4 feet.

Full depth of 16½ feet at all the elbows, and increased width given varying from 160 to 350 feet.

All soundings referred to the zero of the gauge. No complaints were made from vesselmen or owners during the season for want of greater depth in channel. Increased width was needed, and snags, &c., were complained of. The snags were removed from out of the channel, but there was too much work needed to give the necessary depth to allow of anything but the minimum of width in some places, with the removal of only 155,000 cubic yards.

A comparison of the condition of channel with that of close of season of 1883 shows a slight increase in depth, but a slight loss in average width of channel, which would indicate that with the removal of the annual deposits it will be necessary to provide for the removal of over 200,000 cubic yards for some seasons yet, in order to secure the full depth and full width proposed for the improvement.

The total amount appropriated to close of fiscal year for this harbor since 1866 has been $704,700, of which sum $704,446.19 has been expended. The estimated cost of the present project, viz, a channel with a least depth of 16 feet at ordinary low water and 250 feet in width at surface, was $570,000; of this amount $510,000, to close of fiscal year, had already been appropriated.

The balance of $60,000 yet to be appropriated will *not* complete the project as originally estimated, mainly from the lengthened period consumed in doing the work for want of adequate appropriations. The estimate made in 1872 (amended in 1880) contemplated *large* appropriations and consequently limited contingencies, whereas the appropriations have been small, requiring twelve years to obtain $510,000, and contingent expenses and the annual removal of the deposits of each winter and spring have been repeated for these twelve years, so that they have absorbed at least $100,000 of the original estimate. It will therefore require at least $160,000 to complete the projected improvement of the natural channel through Maumee Bay, all of which can be expended in one season in dredging to deepen and widen "the natural channel through Maumee Bay."

The amount of commerce to be benefited is very large and continues to grow in importance; previous reports have given valuable statistics on this subject, to which attention is invited.

The commercial interests of Toledo have taken considerable interest of late in project for "straight channel" to Lake Erie, as approved by Board of Engineers in 1872, and for which a resurvey and estimate of cost was made in 1881, under direction of Maj. John M. Wilson, of the Corps of Engineers, in accordance with act of Congress dated March 3, 1881. Two plans were estimated upon and discussed by Major Wilson in his report. The first was for a straight channel *without* revetment or dikes and estimated to cost $823,813. The second plan was a similar channel, but *with* revetments and dikes estimated to cost $2,363,923 Major Wilson, in concluding the discussion of the plans, writes as follows:

> This second plan I look upon as the most satisfactory solution of the problem of properly improving the harbor of Toledo, Ohio.

I fully agree with him in this conclusion, and if a "straight channel to Lake Erie" be undertaken, it should be upon a plan which provides for revetment and dikes, and with the expectation of its costing about $2,500,000. In the mean time the present project, upon which $510,000 has been expended, and for the completion of which it is estimated that $160,000 more will be required, should be completed, as under favorable appropriations it will be, six or eight years before the "straight channel" is available.

The act of July 5, 1884, appropriated $25,000 to commence the work of making a straight channel for the Maumee River from its mouth to Lake Erie, in accordance with the second plan recommended by Major Wilson in report dated November 19, 1881.

This plan (as before remarked) is estimated to cost $2,363,923, which amount includes item for contingent expenses amounting to $214,902. A work of such magnitude should not be commenced unless with a sum bearing due proportion to the ultimate cost, else the annual loss would largely increase the estimated cost, and in the present case the conditions are such that the amount of work practicable with $25,000 would be obliterated by the elements before another appropriation becomes available. It was therefore recommended that the sum of $25,000 be retained until further appropriations should make a sum large enough to properly commence the work. This was approved by the Chief of Engineers, and no operations were undertaken during the fiscal year ending June 30, 1885, in connection with "straight-channel" improvement.

If the project is to be carried out in accordance with the terms of the first appropriation. then the dredging and diking should be carried on together. Examining the details of the estimate we find 21,000 linear feet of dike from Presque Isle Point, (mouth of river) to the neck of peninsula, to cost $232, 100, to protect the proposed channel to be dredged in the bay. This dredging alongside of this dike for full width and depth of channel is estimated at $424, 678. If we allow for the removal of one-half the width and one-half the depth for the opening season's work, we should require, say, $106, 000 for the dredging, which, added to the diking required, gives $338, 000 as the sum necessary to properly begin the work upon the plan proposed.

If, however, a departure could be made from the terms of the act making the first appropriation for the straight channel, it might be worth the risk to experiment with the small sum (1 per cent. of the estimated cost), and determine whether a cut through Maumee Bay, on the line of the "straight channel," without revetment or dikes, would hold its own, or to what extent it would "fill in" during the winter and spring storms. The result is doubtful, but as there is a *chance* for the cut to hold its own the risk is a fair one, for with a diminution of the diking necessary the cost is rapidly reduced.

Further assuming $250,000 as the *average* annual appropriation for this work, (which sum is a liberal average as appropriations usually are made), it would take ten years to complete the project. The dredging alone could be done in three years with similar appropriations. As the channel would not be of much use to commerce until completed, we should have the money invested from year to year for ten years lying idle, or equating the sums and times we would have $2, 365,000 idle for five years, which at 4 per cent. amounts to nearly $480, 000. This sum added to the cost of dikes, &c., as per estimate gives $2, 203,-000, which capitalized at 4 per cent would yield $88,000 per year with which to maintain the dredged channel. This sum would pay for the annual removal from the new channel of the deposits of each winter and spring, to an extent equal to about one eighth of the whole amount of material originally excavated to make the channel.

As the early completion of the straight channel is a much-desired end, and as dredging gives a tangible result each year, it would seem but a fair business proposition to secure the channel by dredging in three years at about one-third the cost of the whole project, and employ the interest, or a sum of money equal to the remaining two-thirds of cost, in maintaining by annual excavation the newly dredged channel.

All of which would favor the expenditure of the first appropriation in dredging *alone*, provided a departure from the terms of the act of July 5, 1884, is admissible.

Toledo is in the collection district of Miami. There is a fixed white light of the fourth order on Turtle Island, and three sets of range lights for parts of the channel.

The amount of revenue collected during eleven months, ending May 31, 1885, was $14,858.79.

The value of the exports was $701,151.

The collector failed to give the value of the imports. One thousand two hundred and eighty-three vessels, with an aggregate tonnage of 450,001 tons, entered, and 1,276 vessels, with an aggregate tonnage of 447,704 tons, cleared during eleven months ending May 31, 1885.

The deepest draught of vessel entering or clearing was 14.8 feet.

Money statement.

TOLEDO HARBOR, OHIO.

July 1, 1884, amount available	$7,643 09
Amount appropriated by act approved July 5, 1884	20,000 00
	27,643 09
July 1, 1885, amount expended during fiscal year exclusive of outstanding liabilities July 1, 1884	27,389 28
July 1, 1885, amount available	253 81
Amount (estimated) required for completion of existing project	160,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	160,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

TOLEDO HARBOR, OHIO—STRAIGHT CHANNEL.

Amount appropriated by act approved July 5, 1884	$25,000 00
July 1, 1885, amount available	25,000 00
Amount (estimated) required for completion of existing project	2,338,923 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	500,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging 130,000 *cubic yards, more or less, of mud, clay, sand, &c., from the channel through Maumee Bay, Lake Erie, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at* 12 *o'clock, noon, Saturday, August* 23, 1884, *under advertisement of July* 25, 1884.

No.	Names and addresses of bidders.	Rate per cubic yard.	Remarks.
		Cents.	
1	L. P. & J. A. Smith, Cleveland, Ohio	20	
2	George Talbot, Buffalo, N. Y	17	
3 3a	W. E. Rooney, Toledo, Ohio	*14¾ †16	Contract awarded, subject to the approval of the Chief of Engineers, for 65,000 cubic yards.
4	Sheldon & Buck, Toledo, Ohio	20	Bid informal. Guarantee not signed.
5	Fitzsimmons & Connell, Chicago, Ill	26	
6	Chicago Dredging and Dock Company, by C. F. Crane, president, Chicago, Ill	24½	
7	Edwin H. French, Fulton, N. Y	15¾	Contract awarded, subject to the approval of the Chief of Engineers, for 100,000 cubic yards.
8	Carkin, Stickney & Cram, East Saginaw, Mich	19	

000 cubic yards. † 130,000 cubic yards.

Abstract of contracts for improving harbor at Toledo, Ohio, in force during fiscal year ending June 30, 1885.

Names and residences of contractors.	Date of contract.	Subject of contract.	Mud, clay, sand, &c., per cubic yard in scows.	Remarks.
			Cents.	
E. H. French, Fulton, New York	Sept. 4, 1884	Dredging	15¼	Contract completed and closed June 9, 1885.
W. E. Rooney, Toledo, Ohio	Sept. 5, 1884	Dredging	14¾	Contract completed and closed May 18, 1885.

M M 3.

IMPROVEMENT OF PORT CLINTON HARBOR, OHIO.

Port Clinton, Ohio, is situated at the mouth of the Portage River, a stream which rises in the northwestern part of Ohio and empties into Lake Erie.

A history of the operations heretofore carried on for its improvement will be found in Annual Reports of 1880 and 1881.

The present project, adopted in 1875, consists of a pile revetment 967 feet long, running from the north shore of Portage River opposite the town out into the lake, in a direction north 57° east. This revetment then inclines toward the north and extends 301 feet further, when a pile-dike commences, which will be prolonged a total distance of 1,200 feet, out to a depth of 10 feet at the ordinary level of the lake. Parallel to this and 200 feet from it is an east pile-pier, which will be about 2,600 feet long, its inner end resting on the south shore of the river. This east pier will be a simple pile structure of 2,450 feet; the outer 150 feet will be a strong pile-dike 12 feet wide. A channel 10 feet deep will be dredged between the piers.

OPERATIONS DURING THE FISCAL YEAR.

No work in progress during the year, as there were no funds.

The estimated cost of the present project, as submitted in 1875, was $122,000, a revised estimate being for $90,000. The project contemplated the extension of the pier and revetment to the 10-foot depth in lake at ordinary stage of water.

The sum of $46,000 has been appropriated and expended up to the close of the fiscal year ending June 30, 1884, but as the commerce of Port Clinton is small, and prospects for much increase in the near future are not great, it is doubtful whether the expenditure of the remaining $44,000 for the completion of the proposed project, under the revised estimate, would be advisable.

If it is decided to continue the improvement as proposed, the sum of $20,000 can be expended during the period ending June 30, 1887, in prolonging the pier and revetment. An examination of the harbor was made in September, 1883. The depth between the pier and revetment, wherever the same were parallel, was found to be good, averaging from 10 feet to 14½ feet; but at the elbows, where divergence occurs, the depth was only 8 feet. A bar has formed in lake beyond end of pier, with least depth of 7½ feet on crest of bar.

The last river and harbor bill (act of July 5, 1884) made no appropriation of funds for this harbor, hence no work can be done during the fiscal year ending June 30, 1886.

Port Clinton is a port of entry in the collection district of Sandusky, Ohio. The nearest work of defense is Fort Wayne, 60 miles distant, and the nearest light-house is at Green Island, 10 miles distant.

The amount of commerce to be benefited by this improvement is small. For miles above the mouth of Portage River, and bordering upon its banks, are extensive tracts of hard-wood timber, from which lumber, staves, spokes, &c., are made and sent to Port Clinton for shipment.

The amount of revenue collected during eleven months ending May 31, 1885, was $15.25.

There were no imports or exports.

Twenty-six vessels, with an aggregate tonnage of 2,150 tons, entered, and twenty-one vessels, with an aggregate tonnage of 1,898 tons, cleared during eleven months ending May 31, 1885.

The deputy collector of the port states, "that a very small part of vessels that trade from this port do not enter or clear, for they do not trade out of the district.

Money statement.

July 1, 1884, amount available	$29 38
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	11 68
July 1, 1885, amount available	17 70
Amount (estimated) required for completion of existing project	44,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

M M 4.

IMPROVEMENT OF SANDUSKY CITY HARBOR, OHIO.

Sandusky Bay empties into Lake Erie about 40 miles from its western extremity. It is a natural harbor, containing an area of about 22½ miles, with a depth from 8 to 12 feet, protected on the north and northwest from the gales of the lake by a long, narrow peninsula, and on the northeast by what is known as Cedar Point. A full description of the operations carried on in past years for the improvement of this harbor will be found in annual reports of 1880 and 1881.

The present project, adopted in 1880, provides for a channel 200 feet wide and 15 feet deep through the outer bar, and in the bay up to within 50 feet of the line of docks and then parallel to the docks, with a width of 100 feet and depth of 15 feet.

OPERATIONS DURING THE FISCAL YEAR.

At the beginning of the fiscal year there was only a balance of $823.96. No work was in progress nor were any contracts in force.

The act of July 5, 1884, appropriated $20,000 for this harbor, only $10,000 of which were decided as available.

A contract was made with Stang & Gillmore, of Lorain, Ohio, dated August 21, 1884, for the removal of 52,000 cubic yards of material from the channel through the bay and outer bar, to deepen same; at least 15,000 cubic yards to be taken from channel through the bar. Contract price 17½ cents per cubic yard.

Operations were begun at once, and continued with a few slight interruptions, until November 4, 1884, when the contract was closed.

They removed a total of 51,941 cubic yards, which resulted in obtaining a good channel, with least depth of 15½ feet, but not of full width through all the ranges. The condition of channel was better than at the close of the season of 1883, showing an advance in the proposed improvement over the annual "filling in." The outer bar needs most attention where the full width has not as yet been obtained on account of the small appropriations.

The total amount appropriated for this harbor to close of fiscal year has been $265,080, of which sum $254,450.07 has been expended.

It is estimated that $20,000 will be required to complete the present project, the whole of which can be expended in fiscal year ending June 30, 1887. With an increase of commerce at Sandusky an increase to 16 feet in depth of channel will be needed, to make it correspond with other important harbors on Lake Erie and with depth now carried through the Saint Clair Flats Canal. This increased depth, it is estimated, would cost $61,000 additional, making $81,000 required for this harbor, of which some $60,000 can be expended by the close of the fiscal year ending June 30, 1887.

Like all the lake harbors where a dredged channel is the method of improvement, the annual expenditure must be a large one to maintain the channel and remove the material which the winter and spring storms wash into the channel.

In the act of July 5, 1884, the following occurs in connection with Sandusky Harbor:

> Improving harbor at Sandusky City, Ohio: Continuing improvement, twenty thousand dollars; one-half of said sum to be expended in deepening the channel and the other half in the repair of existing works.

Since 1855 there has been no work carried on by the United States for the improvement of Sandusky Harbor other than dredge-work. Previous to and during 1855 a number of rough cribs had been located along the then existing sand-bar or "peninsula," which protected Sandusky Bay on the north and west from the winds and lake waves; but during the winter of 1859 the crib-work was "nearly all destroyed," and no expenditure has since been made towards replacing it. At present there is not a vestige of the cribs to be seen.

There are, therefore, no "existing works" for improving the harbor of Sandusky City, and the $10,000 was not available.

Total amount expended during the year ending June 30, 1885, was $10,194.03.

Sandusky City Harbor is in the collection district of Sandusky Ohio. There is a light-house on Cedar Point, with a fixed white light of the fifth order, and three range-lights within the bay. Fort Wayne, below Detroit, is the nearest work of defense.

The amount of revenue collected during eleven months ending May 31, 1885, was $7,223.23.

The value of the foreign imports was $43,023 and of the foreign exports $30,708.

I was unable to learn the value of the domestic imports and exports.

The imports consisted of—

Iron ore	gross tons	107,704
Anthracite coal	do	32,994
Lumber	feet	50,500,000
Lath	number	3,325,000

Shingles	number..	5,995,000
Salt	barrels..	45,000
Grain	bushels..	859,039

The exports consisted of—

Coal	gross tons..	31,874
Stone	cords..	700
Merchandise	tons..	12,000
Lime	barrels..	37,000

Eight hundred and seventy-eight vessels, with an aggregate tonnage of 222,723 tons, entered, and eight hundred and seventy-three vessels, with an aggregate tonnage of 215,893 tons, cleared during eleven months ending May 31, 1885.

The largest cargo that entered was 1,621 gross tons of iron ore; the largest cargo that cleared was 1,578 tons of coal.

The deepest draught of vessels entering or clearing was 15 feet 9 inches.

Money statement.

July 1, 1884, amount available	$823 96
Amount appropriated by act approved July 5, 1884	20,000 00
	20,823 96
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	10,194 03
July 1, 1885, amount available	629 93
July 1, 1885, amount unavailable	10,000 00
Amount (estimated) required for completion of existing project	10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging 40,000 *cubic yards, more or less, of mud, clay, sand, &c., from the natural channel through Sandusky Bay, and through the outer bar, to deepen same, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at* 12 *o'clock noon, Tuesday, August* 12, 1884, *under advertisement of July* 25, 1884.

No.	Names and addresses of bidders.	Rate per cubic yard.	Remarks.
		Cents.	
1	George Talbot, Buffalo, N. Y.	24	
2	Sheldon, Bucks & Co., Toledo, Ohio	22	
3	L. P. & J. A. Smith, Cleveland, Ohio	21	
4	Willam E. Rooney, Toledo, Ohio	18	
5	Stang & Gillmore, Lorain, Ohio	17½	Contract awarded subject to the approval of the Chief of Engineers.
6	Edwin H. French, Fulton, N. Y.	25	

Contract entered into with Stang & Gillmore; dated August 21, 1884; completed November 5, 1884.

M M 5.

IMPROVEMENT OF SANDUSKY RIVER, OHIO.

The Sandusky River rises in Richland County, Ohio, and after a very circuitous course empties in Sandusky Bay about 14½ miles from Cedar Point, where the bay empties into Lake Erie.

Fremont, the head of navigation, is 17 miles from the mouth of the river. It is a city of about 9,000 inhabitants, and the market place of a large and productive surrounding country. A history of the work carried on in past years for the improvement of the river will be found in Annual Report for 1881.

The present project, adopted in 1880, provides for dredging a channel 100 feet wide and 9 feet deep through the various bars between the city of Fremont and the depth of 9 feet in Sandusky Bay.

Major Wilson, Corps of Engineers, the then officer in charge, in his annual report for 1882, writes as follows:

> I am satisfied that but little difficulty will be experienced in keeping open at all times a good channel with a depth of 9 feet between Fremont and the mouth of the river; but the character of the materials composing the outer bar is such that I deem it exceedingly doubtful whether the channel lately dredged through it will remain open for any length of time. I feel sure that no permanent improvement can be maintained without an elaborate system of dikes, the expense of which would not be warranted by the present limited commerce of the port.

OPERATIONS DURING THE FISCAL YEAR.

Balance of appropriation under act of August 2, 1882, at beginning of fiscal year was $628.47.

No further appropriation has been made since. The amount on hand was too small to attempt any new work and was reserved for some contingency pending further appropriations.

No work was done during the fiscal year.

There have been no complaints from vessel-men as to the condition of the channel, nor requests for additional improvements; hence it is assumed that the river in present condition answers all demands of the commerce navigating it.

The estimated cost of the present project is $44,000; of this amount $21,500 has been appropriated; $10,000 can be expended during the period ending June 30, 1887.

Total amount appropriated for this river to date is $51,500, of which sum $50,871.53 has been expended.

The last river and harbor bill (act of July 5, 1884) made no appropriation of funds for this river; hence no work can be done during the fiscal year, ending June 30, 1887.

Fremont, the head of navigation, is in the collection district of Sandusky, Ohio. The nearest light-house is at Cedar Point, the entrance to Sandusky Bay. Fort Wayne, near Detroit, Mich., is the nearest work of defense.

The collector of the port of Sandusky, Ohio, in whose collection district is the port of Fremont, reports that during the eleven months ending May 31, 1885, the business at the port of Fremont was so very small that it is not worth considering.

Money statement.

July 1, 1884, amount available	$628 47
July 1, 1885, amount available	628 47
Amount (estimated) required for completion of existing project	22,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

M M 6.

IMPROVEMENT OF HURON HARBOR, OHIO.

The Huron River rises in the northern part of Ohio, and after a very circuitous course empties into Lake Erie about 10 miles east of Sandusky City. For a history of the operations carried on in past years for the improvement of this harbor, see the Annual Reports of 1880, 1881, and 1883.

OPERATIONS FOR THE FISCAL YEAR.

The act of July 5, 1884, appropriated $7,500 for this harbor. A contract was made dated September 5, 1884, with L. P. & J. A. Smith, of Cleveland, Ohio, for repairs to piers and dredging, also modification to contract dated October 22, 1884, Operations were begun September 5, with dredging from bar in lake beyond end of piers, 501½ cubic yards of material were excavated, which removed the small bar which had formed, and restored the channel to full 15 feet depth. This dredging occupied only two days.

Repairs to piers were commenced September 13, 1884, and continued with slight interruptions until December 15, 1884, when the contract was completed and closed.

The following materials were used in the repairs:

White-pine timber	feet, B. M.	55,829
White-pine plank	do	13,050
White-oak timber	do	20,668
White-oak plank	do	4,124
White-oak piles	linear feet	7,077
Screw and washer bolts	pounds	4,611
Drift bolts	do	5,556
Tie-rods	do	1,736
Wrought spike	do	1,181
Brush	cords	16¾
Filling stone	do	105.88

And such old United States material as could be utilized.

With the above materials, and necessary labor, the following work was done:

One hundred and eighty-five linear feet of west pier was torn down to 1 foot below low-water mark and the "overhang" torn out to bottom of channel and then rebuilt with a pile-pier; 576 linear feet (not continuous) of the superstructure of west pier was repaired.

Forty-eighth linear feet of pile-protection was constructed for channel face of east pier and 72 linear feet of pile-protection of same pier was repaired.

Sixty-two linear feet of the shore breakwater at inner end of west pier was repaired besides minor repairs to both piers.

Total amount expended during the fiscal year was $7,293.81. The piers were left in only moderate repair.

The entire amount appropriated to date (June 30, 1885) for this harbor has been $114,273.71, all of which has been expended except $213.07 and has given a good channel with 15 feet at low water.

An examination was made of this harbor in September, 1884, and showed a fair channel with least depth of 16 feet and in such condition that a little work would secure a channel depth of 17 feet.

As Huron is one of the best natural harbors on Lake Erie it will be proper, if the commerce of Huron increases to extend the piers, out to the 16 foot curve in the lake.

The Wheeling and Lake Erie Railroad Company have expended considerable for docks and slips at this harbor with view to shipment of coal, &c. The records of the custom-house, however, show that at present the amount of commerce to be benefited by further improvements at this harbor is small. The piers are in bad condition, and further repairs are badly needed to prevent a serious breach between inner end of east pier and the land.

The estimated cost of renewing the superstructure of the piers was $22,000; $13,500 has been appropriated, but owing to the extra repairs made necessary by the storms of 1883 and 1884, the estimate to complete the renewals should be $15,000 (rather than the remaining balance of $8,500), which increased amount can be expended during fiscal year ending June 30, 1887, in rebuilding superstructure, repairing piers, &c.

Huron Harbor is in the collection district of Sandusky, Ohio. Fort Wayne, Mich., about 70 miles distant, is the nearest work of defense. There is a fixed white light of the fourth order on the outer end of the west pier.

The amount of revenue collected during eleven months ending May 31, 1885, was $28.75.

The value of the imports was $59,437, and the value of the exports was $55,280.20 during eleven months ending May 31, 1885.

Fifty-five vessels with an aggregate tonnage of 16,090 tons entered and cleared during eleven months ending May 31, 1885.

The deputy collector reports that the greater part of the larger vessels doing business at Huron are engaged within the limits of the customs district, and are not obliged to enter or clear; hence are not recorded at the office.

Money statement.

July 1, 1884, amount available	$6 88
Amount appropriated by act approved July 5, 1884	7,500 00
	7,506 88
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,293 81
July 1, 1885, amount available	213 07
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for repairs to piers and for dredging at Huron Harbor, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at 12 *o'clock noon, Monday, August* 25, 1884, *under advertisement of July* 25, 1884.

[Approximate quantities.]

Materials.	L. P. & J. A. Smith, Cleveland, Ohio.*		John Stang, Lorain, Ohio.	
	Price per unit.	Amount.	Price per unit.	Amount.
2,443 linear feet, more or less, white oak or red elm piles, driven and cut off ...... per linear foot..	$0 29	$708 47	$0 30	$732 90
1,332 linear feet, more or less, white oak or red elm piles for ties and back logs .... per linear foot..	24	319 68	25	333 00
78,930 feet, B. M., more or less, white pine timber and plank, including labor ....per M feet, B. M..	33 00	2,604 69	34 00	2,683 62
23,160 feet, B. M., more or less, white oak timber and plank, including labor ....per M feet, B. M..	30 00	694 80	40 00	926 40
1,620 pounds, more or less, iron tie-rods ......per pound..	....	72 90	04	64 80
3,809 pounds, more or less, screw and washer bolts, per pound	05	190 45	04	152 36
4,150 pounds, more or less, drift-bolts ....per pound..	04½	186 75	04	166 00
44 cords, more or less, fascines and brush .....per cord..	3 00	132 00	3 00	132 00
155 cords more or less stone (filling) ... .do...	5 00	775 00	5 00	775 00
500 cubic yards, more or less, dredging and removing material ....per cubic yard..	70	350 00	50	250 00
912 pounds, more or less, wrought spike .....per pound..	....	41 04	04	36 48
Totals	....	6,075 78	....	6,252 56

* Bid not complete; no price for iron tie-rods and spike. Considered immaterial, and recommend award of contract, subject to approval of Chief of Engineers.

The items of tie-rods and spike in bid No. 1 are calculated on basis of price for drift-bolts, viz, 4½ cents per pound, and the aggregate thereby obtained for comparison with No. 2 bid.

Abstract of contracts for improving harbor at Huron, Ohio, in force during fiscal year ending June 30, 1885.

Names and residence of contractors.	Date.	Subject of contract.	White-pine timber, per M feet, B. M.	White-pine plank, per M feet, B. M.	White-oak timber, per M feet, B. M.	White-oak plank, per M feet, B. M.	White-oak or red elm piles, per linear foot, driven and cut off.	White-oak or red elm piles, per linear foot (back logs).
L. P. & J. A. Smith, Cleveland, Ohio.	Sept. 5, 1884	Dredging, repairs and construction.	$33 00	$33 00	$30 00	$30 00	$0 29	$0 24
Modification of above contract.	Oct. 11, 1884		....	....	....	....	....	....

Names and residence of contractors.	Filling-stones, per cord.	Brush, per cord.	Dredging and depositing material, per cubic yard.	Screw and washer bolts (iron), per pound.	Drift-bolts (iron), per pound.	Tie-rods (iron), per pound.	Wrought spike (iron), per pound.	Removing overhanging portion of west pier, per linear foot.
L. P. & J. A. Smith, Cleveland, Ohio.	$5 00	$3 00	$0 70	$0 05	$0 04½	$0 04½	$0 04½	....
Modification of above contract.	....	....	....	....	....	....	....	$1 50

Contract completed and closed, December 13, 1884.

M M 7.

IMPROVEMENT OF VERMILLION HARBOR, OHIO.

The Vermillion River rises in the northern part of Ohio and empties into Lake Erie about 20 miles to the eastward of Sandusky City.

A history of the operations carried on in past years for the improvement of this harbor will be found in Annual Reports of 1880 and 1881.

The project of improvement, which was adopted in 1836, when there was a depth of less than 2 feet of water on the bar at the entrance, and which project has been amended from time to time, as the requirements of commerce demanded deeper water, consists of parallel piers 125 feet apart running out to a depth of 12 feet in the lake.

OPERATIONS FOR THE FISCAL YEAR.

At the opening of the fiscal year there was a balance on hand of $915.08 for this harbor. No further appropriation was made during the fiscal year, and no work was done during the year for want of sufficient funds.

An examination of this harbor was made in November, 1884, which showed that there was a good channel with least depth of 12 feet from lake to town landing.

The proposed project for this harbor provides for opening a channel 100 feet wide and 14 feet deep from lake to the lower end of the docks at Vermillion; this channel to be secured by removing about 2,000 cubic yards of rock and about 25,000 cubic yards of gravel, sand, shale, &c., at an estimated cost of $15,000. The piers need further repairs, estimated to cost $2,000, making a total of $17,000 for the project.

The sand is steadily encroaching around the ends of the piers into the channel, and to arrest the progress it will be necessary to extend the piers, say, 500 feet farther into the lake, at a cost of about $70,000. With the present limited commerce of Vermillion such an expenditure is not advisable.

As but $3,000 of the estimated $17,000 for proposed project has been appropriated, and $2,084.92 of it expended in *repairs*, it is doubtful whether anything but the keeping of the existing construction in good condition should be undertaken until an increase of commerce shall require an increase of channel depth.

The total amount appropriated for this harbor to date is $114,942.32, of which sum $114,033.64 has been expended.

The last river and harbor bill (act of July 5, 1884) made no appropriation of funds for this harbor, hence, no work can be done during the fiscal year ending June 30, 1886.

Vermillion Harbor is in the collection district of Sandusky, Ohio. There is a fixed light of the fifth order on the west pier. Fort Wayne, Mich., 80 miles distant, is the nearest work of defense. The amount of revenue collected during the eleven months ending May 31, 1885, was $6.50. Nineteen vessels, with an aggregate tonnage of 4,671 tons, entered, and twenty vessels, with an aggregate tonnage of 5,122 tons, cleared, during eleven months ending May 31, 1885. The value of the imports was about $16,100 and of the exports about $700.

The deepest draught of any vessel entering the harbor was 13 feet.

The imports consisted of pine lumber, laths, and limestone; the exports, of oak ship-timber.

Money statement.

July 1, 1884, amount available	$915 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6 40
July 1, 1885, amount available	908 68
Amount (estimated) required for completion of existing project	14,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	14,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

M M 8.

IMPROVEMENT OF HARBOR AT MOUTH OF BLACK RIVER, OHIO.

Black River, Ohio, is formed by two branches, nearly equal in size, which, rising in Lorain County, Ohio, and flowing northward, unite about 8 miles from the town of Lorain, where the river empties into Lake Erie.

A history of the operations carried on during the last fifty-four years, whereby the depth at the entrance to this harbor has been increased from about 3 to at least 16 feet, will be found in annual reports of 1880 and 1881.

The project of improvement submitted in 1828, and amended from time to time as the demands of commerce called for an increased depth in the channel, consists of parallel piers, 200 feet apart, running out from the shore on each side of the mouth of the river to a depth of 16 feet in the lake.

OPERATIONS DURING THE FISCAL YEAR.

The act of July 5, 1884, appropriated $10,000 for this harbor, making $10,151.57 available for the fiscal year.

A contract was made with John Stang, of Lorain, Ohio, for repairs to piers. Work was begun in September and continued until December 20, when bad weather necessitated a suspension. Work was resumed May 20, 1885, and contract closed June 20, 1885, by exhaustion of funds.

The operations under this contract consisted in renewing about 656 linear feet of the superstructure of the east pier, including new decking; in constructing 262 linear feet of pile protection to the channel face of west pier, and 225 linear feet of pile protection to the east pier; in renewing 158 linear feet of decking at inner end of east pier; renewing fender-piles at end of both piers; repairing bad break in west pier, and in general repairs to both piers, both above and below water surface.

The following materials were expended under this contract in the above repairs:

Pine timber	feet, B M	92,451
Pine plank	do	30,163
Oak timber	do	24,256
Oak plank	do	4,372
Oak piles	linear feet	9,692
Stone	cords	179.38
Brush	do	2
Screw and washer bolts	pounds	1.746
Drift-bolts	do	6.484
Spikes	do	1.968

And such old material as could be utilized.

The whole amount expended under this contract was $8,478.73.

It was found in April, 1885, that a slight shoaling of channel depth between the piers had occurred, and as the demands of commerce were pressing, authority was obtained to remove the deposits by dredge-work at once. An agreement was entered into with Stang & Gillmore, of Lorain, Ohio, at the rate of 21 cents per cubic yard. Operations were begun May 2 and completed May 14, 1885. They removed 3,331 cubic yards of material and restored a good 16-foot channel between the piers from the lake to the ore docks at inner end of piers. The Cleveland, Lorain and Wheeling Railroad Company also did some dredging near the railroad docks to restore the full 16-foot depth of channel.

The total amount expended during the fiscal year was $10,151.21, leaving only a balance of 36 cents, so that no work will be practicable at this harbor during the fiscal year ending June 30, 1886, unless special appropriation is made.

The work during the year has placed the piers in fair repair, considering their *age* and the limited amount expended, and given a *good* 16-foot channel of entrance.

The present project provides for prolonging the west pier 180 feet and the east pier 120 feet, and of renewing about 200 linear feet of superstructure, at an estimated cost of $45,000. Of this amount $27,000 has already been appropriated, but unexpected repairs, made and to be made, will make it necessary to still provide about $30,000 for completion of the existing project; $20,000 of same can be expended during the fiscal year ending June 30, 1887, in prolonging the piers and renewing the superstructure. Total amount appropriated for this harbor to date has been $210,138.73, of which sum $210,138.37 has been expended, with which a good 16-foot channel has been obtained.

The commerce of this harbor is increasing, and it is therefore important that the proposed extension of piers should be carried out at as early a date as possible, to prevent a recurrence of the shoaling at entrance of harbor.

The whole amount required, $30,000, should be appropriated in one allotment, and it could be profitably expended during the fiscal year ending June 30, 1887.

Black River is in the collection district of Cuyahoga, Ohio. The commerce is increasing, and the harbor is destined to take high rank with the others on the lakes. Its trade in coal and iron is daily becoming more valuable. It is the lake terminus of the Cleveland, Lorain and Wheeling Railroad, which has direct connection with the Ohio River.

There is a fixed white light of the fourth order at the outer end of the west pier. The nearest work of defense is Fort Wayne, Mich., 80 miles distant. The value of the imports was $282,988, and of the exports $574,938, during the season of 1884. Ninety-six vessels, with an aggregate tonnage of 26,061 tons, entered, and 166 vessels, with an aggregate tonnage of 50,625 tons, cleared, during season of 1884 (vessels engaged in the coasting trade). One hundred and thirty-six vessels, with an aggregate tonnage of 24,828 tons, entered, and 153 vessels, with an aggregate tonnage of 28,222 tons, cleared, during season of 1884 (vessels engaged in the foreign trade).

Attention is called to the fact that the above statement of commerce is for the season of 1884, and not for the twelve months ending June 30, 1885.

Money statement.

July 1, 1884, amount available	$151 57
Amount appropriated by act approved July 5, 1884	10,000 00
	10,151 57
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	10,151 21
July 1, 1885, amount available	36
Amount (estimated) required for completion of existing project	30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for repairs to piers at mouth of Black River, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at 12 o'clock, noon, Tuesday, August 26, 1884, under advertisement of July 25, 1884.

No.	Names and addresses of bidders.	Materials.	Amount.
1	Daniel M. Averill, Cleveland, Ohio.*	7,225 linear feet, more or less, white oak or red elm piles, including driving, at 32 cents per linear foot.	$2,312 00
		90,573 feet B. M., more or less, white pine timber and plank, including labor, at $32 per M feet B. M.	2,898 34
		15,350 feet B. M., more or less, white oak timber and plank, including labor, at $36 per M feet B. M.	552 60
		40 cords, more or less, brush, at $4 per cord	160 00
		150 cords, more or less, stone (filling), at $5 per cord.	750 00
		450 pounds, more or less, iron tie-rods, at 3½ cents per pound.	**15 75**
		689 pounds, more or less, screw and washer bolts, at 3½ cents per pound.	24 11
		4,000 pounds, more or less, drift bolts, at 3½ cents per pound.	140 00
		1,165 pounds, more or less, wrought spike, at 3½ cents per pound.	40 77
		Bracing up 220 linear feet, more or less, of elevated walk, at 40 cents per linear foot.	**88 00**
			6,981 57

* Bid incomplete. No price for tie-rods or for bracing up elevated walk. Amounts printed in heavy type price for said items.

Abstract of proposals for repairs to piers at mouth of Black River, Ohio, &c.—Cont'd.

No.	Names and addresses of bidders.	Materials.	Amount.
2	Charles A. Sturtevant, Lorain, Ohio.*	7,225 linear feet, more or less, white oak or red elm piles, including driving, at 33 cents per linear foot.	$2,384 25
		90,573 feet B. M., more or less, white pine timber and plank, including labor, at $26.50 per M feet B. M.	2,400 18
		15,350 feet B. M., more or less, white oak timber and plank, including labor, at $36 per M feet B. M.	552 60
		40 cords, more or less, brush, at $2 per cord	80 00
		150 cords, more or less, stone (filling), at $5.75 per cord.	862 50
		450 pounds, more or less, iron tie-rods, at 4 cents per pound.	18 00
		689 pounds, more or less, screw and washer bolts, at 4 cents per pound.	27 56
		4,000 pounds, more or less, drift-bolts, at 4 cents per pound.	160 00
		1,165 pounds, more or less, wrought spike, at 4 cents per pound.	46 60
		Bracing up 220 linear feet, more or less, of elevated walk, at 75 cents per linear foot.	165 00
			6,696 69
3	John Stang, Lorain, Ohio† ...	7,225 linear feet, more or less, white oak or red elm piles, including driving, at 28 cents per linear foot.	2,023 00
		90,573 feet B. M., more or less, white pine timber and plank, including labor, at $30 per M feet B. M.	2,717 19
		15,350 feet B. M., more or less, white oak timber and plank, including labor, at $32 per M feet B. M.	491 20
		40 cords, more or less, brush, at $2 per cord........	80 00
		150 cords, more or less, stone (filling), at $4.70 per cord.	705 00
		450 pounds, more or less, iron tie-rods, at 4 cents per pound.	18 00
		689 pounds, more or less, screw and washer bolts, at 4 cents per pound.	27 56
		4,000 pounds, more or less, drift bolts, at 3 cents per pound.	120 00
		1,165 pounds, more or less, wrought spike, at 3 cents per pound.	34 95
		Bracing up 220 linear feet, more or less, of elevated walk, at 75 cents per linear foot.	....
			(6,381 90)
			6,216 90
4	L. P. & J. A. Smith, Cleveland, Ohio.	7,225 linear feet, more or less, white oak or red elm piles, including driving, at 26 cents per linear foot.	1,878 50
		90,573 feet B. M., more or less, white pine timber and plank, including labor, at $32 per M feet B. M.	2,898 34
		15,350 feet B. M., more or less, white oak timber and plank, including labor, at $30 per M feet B. M.	460 50
		40 cords, more or less, brush, at $2.75 per cord	110 00
		150 cords, more or less, stone (filling), at $5 per cord	750 00
		450 pounds, more or less, iron tie-rods, at 4 cents per pound.	18 00
		689 pounds, more or less, screw and washer bolts, at 4 cents per pound.	27 56
		4,000 pounds, more or less, drift-bolts, at 4 cents per pound.	160 00
		1,165 pounds, more or less, wrought spike, at 3½ cents per pound.	40 77
		Bracing up 220 linear feet, more or less, of elevated walk, at 40 cents per linear foot.	88 00
			6,431 67

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* Extra item in bid, snubbing-posts 36 cents per linear foot; this price is equivalent to $30 per M feet B. M., for the quantity of oak in snubbing-posts. Total is estimated not to include the price for snubbing-posts.

† Bid incomplete. No price named for bracing up the elevated walk. Total obtained by taking the maximum figure for said item, viz, 75 cents, would still make the bid the lowest; omission not considered material. Recommend that this bid be accepted, subject to the approval of the Chief of Engineers.

Contract entered into with John Stang, dated September 8, 1884; completed June 19, 1885.

M M 9.

IMPROVEMENT OF MOUTH OF ROCKY RIVER, OHIO.

Rocky River rises in the northern part of Ohio, and, flowing north, empties into Lake Erie, about 5 miles west of Cleveland.

A history of the operations heretofore carried on at this place under various acts of Congress will be found in the Annual Reports of the Chief of Engineers for 1880 and 1881.

The violent storms of the springs of 1883 and 1884 did considerable damage to the pier at this harbor.

OPERATIONS FOR THE FISCAL YEAR.

Balance on hand at beginning of the fiscal year of appropriation under act of June 14, 1880, was $131.87, and no further appropriation was made during the fiscal year. No work done during the fiscal year for want of funds. The mouth of Rocky River is not a port; it has no commerce, and any expenditures of funds for its improvement beyond necessary repairs to the existing pier is not deemed advisable.

The Cleveland harbor of refuge is only 5 miles distant. An appropriation of $3,000 for repairs is all that is required at present. The total amount appropriated for the river mouth to present date has been $39,000, of which sum $38,868.13 has been expended.

An examination of the river made in October, 1883, showed that there was a fair channel 150 feet wide, with least depth of 7 feet from Lake to head of Island No. 1 inside the pier; all that the commerce of the river calls for.

The last river and harbor bill (act of July 5, 1884), made no appropriation of funds for this harbor, hence no repairs can be made during the fiscal year ending June 30, 1886, and this delay will increase the amount of repairs now necessary.

The nearest light-house is at Cleveland. The nearest work of defense is at Fort Wayne, Mich., 106 miles distant.

Money statement.

July 1, 1884, amount available	$131 87
July 1, 1885, amount available	131 87
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	3,000 00

M M 10.

IMPROVEMENT OF CLEVELAND HARBOR, OHIO.

Cleveland, Ohio, is situated at the mouth of the Cuyahoga River. This river rises in the northern part of Ohio, and, after a very circuitous course, empties into Lake Erie. A description of the operations carried on in past years for the improvement of this harbor will be found in Annual Reports of 1880 and 1881.

The original project of improvement, adopted in 1825, when there was a depth of only 3 feet in the narrow and crooked channel at the entrance, and which project has been amended from time to time, as the demands of commerce called for an increase depth of water, provides for parallel piers, 200 feet apart, running out to a depth of 16 feet in the lake. "This project is completed."

In 1875, in accordance with an act of Congress, a plan was submitted for a harbor of refuge at this place.

This plan, which, after amendment by the Chief of Engineers, was approved by the Secretary of War, provided for an outer breakwater in a depth of about 5 fathoms, connected at its west end with the main shore; the entrance, near the east end, was to be protected by extending the west pier at the mouth of the river, "according to present plan."

The original project of the Board of Engineers provided for prolonging the west pier, but such earnest protests were made against this by parties interested in commerce, and such urgent appeals made for the extension of the east pier instead, that the honorable Secretary of War, before whom these facts were placed, decided to comply with the wishes of the mariners, and has directed that the east, instead of the west, should be prolonged. This plan has been still further amended as will be seen from detail given later in this report.

The shore arm of the breakwater starts from a point about 700 feet west of the extremity of the old bed of the Cuyahoga River, and runs out into the lake, in a direction nearly due north, a distance of 3,130 feet. The lake arm, which is about parallel with the main shore, is 4,030 feet long, and at a point 200 feet from its eastern extremity a spur 100 feet long runs out at right angles, so as to break the force of the heavy sea rolling along the breakwater during westerly and northwesterly gales.

All this portion was completed in December, 1883.

OPERATIONS DURING THE FISCAL YEAR.

At the beginning of the fiscal year there were no contracts in force, and the balance of funds on hand was only $19,239.73. Dredging between piers and in lake beyond end of piers was in progress, under agreement with L. P. and J. A. Smith, of Cleveland, Ohio. This dredging was completed July 9, 1884. The quantity removed during the past month was 1,034 cubic yards, making a total of 11,803 cubic yards removed under the agreement, at a cost of $2,891.86, which restored a good channel for full width, with least depth of 17 feet from lake to the railroad bridge at the inner end of piers.

Repairs to piers by hired labor and purchase in open market were commenced July 22, 1884, and continued from time to time, and with numerous interruptions, until beginning of October, 1884.

The following work was done:

163 linear feet of decking of east pier renewed.

80 linear feet of decking of west pier renewed.

304 linear feet of the waling sticks of east pier were renewed.

Broken pockets in cribs of east pier repaired, sheathed with plank and refilled with stone.. Inner end of the east pier on east side was sheathed with heavy plank and riprap stone placed in angle. The United States Engineer boat-house was repaired and painted. Some repairs to the decking of the pile portion of the shore arm of the breakwater was also done, and sheathing plank *fastened* under water by hired labor, near settled part of breakwater.

For the thorough repair of the settled portion of breakwater damaged in November, 1883, a contract was made with John Stang, of Lorain, Ohio, dated July 21, 1884. Work was begun July 30, and continued, with some interruptions, until September 30, when contract was completed and closed.

The following materials were expended in these repairs:

White-pine timber	feet, B. M.	90,116
White-pine plank	do	40,330
White-oak timber	do	19,168¼
Drift-bolts	pounds	4,522
Spike	do	4,013¼
Stone (filling)	cords	326.65
Stone (riprap)	tons	2,003.68

With which, and by the use of a large quantity of old material, about 300 linear feet (not continuous) of the lake arm of the breakwater was repaired and rebuilt to original height, and many broken deck joists and deck plank repaired, and stone filling replaced where slight settlement had occurred. The north face of breakwater for 37 linear feet and the south face for 29 linear feet, where greatest settlement occurred, were sheathed with 6-inch oak plank thoroughly fastened with button-headed bolts and a large quantity of rip-rap stone used to solidify the foundation. The lake arm of breakwater was thereby placed in good repair. The total expended under this contract was $10,600.52.

During October, November, and December, work was in progress by hired labor in placing boiler-iron plates near junction between crib top and lower course of superstructure to close opening between same, and to prevent the chafing of the timbers by ice. Some twelve plates of iron, ½ by 36 by 72 inches were affixed with fifty-two button-headed bolts in each plate, so that 18 inches of the width in each plate was below *low-water level*. The work was tedious and much delayed at that season of the year.

The amount expended during the fiscal year on piers and breakwater by hired labor and purchase in open market was about $3,200.

At the close of the fiscal year ending June 30, 1885, the piers were in fair repair and the breakwater in fair condition and withstanding very well the action of the storms.

Some slight repairs are needed to both piers and to breakwater, which will be done during August and September, 1885.

There was a good 16½-foot channel between piers, and in lake beyond end of piers.

COMPLETION OF HARBOR OF REFUGE.

In May, 1884, I had submitted to the Chief of Engineers a proposed change in plan for completing the harbor of refuge; to build an eastern arm of breakwater, instead of prolonging the east pier, which change received favorable consideration by the Chief of Engineers. It was, however, deemed necessary to obtain sanction of Congress, and I was instructed to call attention to said change of plan in my annual report for the fiscal year ending June 30, 1884.

The act of July 5, 1884, appropriated the sum of $100,000 for improving harbor at Cleveland, Ohio. When project for the expenditure of this sum was asked for by the Chief of Engineers, United States Army, I submitted plan for construction of cribs and foundation, the cribs to be built during fall and winter of 1884, the foundation to be built and cribs sunk in spring of 1885, by which time Congress would have had opportunity to sanction or disapprove of the proposed change of plan.

The Chief of Engineers, United States Army, referred the subject to the Secretary of War, and requested that a Board of Engineers might be assembled to examine and report upon the proposed change of plan.

The Secretary of War ordered a Board of Engineers, which assembled September 10, 1884, at Cleveland, Ohio. This Board, after an examination of the project, and an interchange of views with vessel owners, vessel masters, and others interested in commerce of the lakes, submitted a report recommending a change in plan for completing the harbor of refuge, which, although a modification of the plan of the engineer in charge, substantially indorsed the same. It provided for an eastern breakwater, beginning at a point on the prolongation of the lake-arm of the west breakwater, and 500 *feet from it*, and running in all about 3,500 feet in a broken line, with two salient angles, convex towards the lake ending, about 2,600 feet from the shore in a depth of 25 feet of water, and having between its eastern end and the curve of 14 feet depth of water an entrance 1,200 feet wide.

Such a breakwater would give an increased area for anchorage between it and the 14-foot curve of about one hundred and twenty acres during northwest gales, and about seventy acres during northeast gales. It would protect the present harbor on the west side during easterly gales, and would afford safe and convenient anchorage for vessels running into the harbor during westerly gales.

The Board also recommends the construction of a parapet about 4 feet high and 16 feet wide on the present west breakwater, to prevent the pouring over into the harbor of the large volume of water thrown therein during heavy gales, which it is asserted raises the level of the water within the harbor to such an extent as to produce a very strong current out of it at the entrance.

The cost of such a parapet would probably be about	$60,000
The cost of the proposed east breakwater, 3,500 feet long, would be about	440,000
Total	500,000

The estimated cost of this harbor of refuge as originally projected and approved was $1,800,000. The amount expended up to the present time, the west breakwater being completed as originally designed, is $800,000. If the work now recommended be constructed the total cost of the harbor of refuge under the project now submitted will be about $1,300,000, which is $500,000 less than the original estimate.

The Board further recommends, in order that the present harbor may completely fulfill the objects for which it was constructed, that a harbor-master be appointed, and that a strong sea-going tug be employed during the season of navigation to tow in and place vessels which cannot be handled by the river tugs.

With a slight modification, this report was approved by the Chief of Engineers, United States Army, and referred to the Secretary of War, who approved of the amended report, but deeming the sanction of Congress to the change of plan necessary, referred the whole matter to the House of Representatives.

To the bill prepared by Committee on Rivers and Harbors of the House of Representatives, making appropriation for rivers and harbors for the fiscal year ending June 30, 1886, an amendment to the clause relating to Cleveland Harbor was made sanctioning the proposed change of plan for harbor of refuge at Cleveland, Ohio.

This bill failed to pass, so that no action was taken towards making the $100,000 of the act of July 5, 1884, available towards completing the breakwater upon the approved plan.

As the Forty-ninth Congress does not assemble until December, 1885, the sanction deemed necessary for the expenditure of the $100,000 for an eastern arm of breakwater cannot be obtained *before* the end of the year 1885, and no active work will be practicable before March, 1886, thereby resulting in a loss of over two years' time in completion of the harbor of refuge. The original estimate for the harbor of refuge was $1,800,000. About $800,000 has been expended and five-sixth, of the original plan completed. The proposed change of plan is estimated to cost $440,000, so that the harbor of refuge with an eastern breakwater can be completed for about $500,000 less than the original estimate.

The amount (estimated) required for the completion of *existing* project is $300,000, and for completion of the approved change in project is $400,000, either of which sums should be appropriated in one allotment, and can be profitably expended during the fiscal year ending June 30, 1887.

The balance on hand July 1, 1884, when all outstanding contracts were completed, was only $19,239.73, too small a sum to invite proposals for continuing the breakwater this season. Hence there has been no work done during the fiscal year ending June 30, 1885.

The harbor of refuge as originally planned would, if completed, be about 1 mile long, and offer an area of one hundred and eighty acres for anchorage, the depth in one hundred and forty acres of which will be from 17 to 29 feet. The proposed change would give about three hundred acres of harbor room and about two hundred and fifty acres with the maximum depth. The total expenditure for the fiscal year ending June 30, 1885, including repairs, dredging, contingencies, &c., was $18,104.44. Total appropriated to July 1, 1885, for the harbor of refuge is $900,000, of which sum $795,072.85 has been expended to June 30, 1885, less about $30,000 expended in repairs to piers, dredging, &c., for Cleveland Harbor proper.

Cleveland Harbor is in the collection district of Cuyahoga, Ohio. There is a fixed white light of the third order on shore and a beacon on the outer end of each pier. The nearest work of defense is Fort Wayne, Mich., 110 miles distant.

The value of the imports (coastwise) was $45,815,053, and of the exports (coastwise) was $35,416,638. The value of the imports (foreign) was $5,711,445, and of the exports (foreign) $485,783 during the season of 1884. Two thousand six hundred and forty-nine vessels (engaged in the coasting trade), with an aggregate tonnage of 1,140,007 tons, entered, and two thousand five hundred and fifty-five vessels, with an aggregate tonnage of 1,120,046 tons, cleared during the season of 1884. Three hundred and seventy-two vessels (engaged in the foreign trade), with an aggregate tonnage of 76,721 tons, entered, and four hundred and eighty vessels, with an aggregate tonnage of 126,101 tons, cleared during the season of 1884.

The collector failed to state the amount of revenue collected.

Money statement.

July 1, 1884, amount available	$19,239 73
Amount appropriated by act approved July 5, 1884	100,000 00
	119,239 73
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	18,104 44
July 1, 1885, amount available	1,135 29
July 1, 1885, amount unavailable	100,000 00
Amount (estimated) required for completion of existing project	300,000 00
Amount (estimated) required for completion of proposed project	400,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	300,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887, for proposed project	400,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for repairing a portion of the lake-arm of the breakwater at Cleveland, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at 12 o'clock noon, Monday, July 14, 1884, under advertisement of June 14, 1884.

Material.	Louis P. & James A. Smith, Cleveland, Ohio.		John Stang, Lorain, Lorain County, Ohio.*	
	Price per unit.	Amount.	Price per unit.	Amount.
White-pine timber and plank, 124,863 feet, B. M., more or less ...... per M feet, B. M..	$36 00	$4,495 07	$35 00	$4,370 20
White-oak timber and plank, 14,987 feet, B. M., more or less ...... per M feet, B. M..	40 00	599 48	35 00	524 55
Stone for filling 200 cords, more or less ...... per cord.	6 00	1,200 00	5 70	1,140 00
Stone for riprap, 1,200 tons, more or less ...... per ton..	2 00	2,400 00	1 60	1,920 00
Drift-bolts, 2,400 pounds, more or less ...... per pound..	04½	108 00	03	72 00
Boat-spike with large heads, 2,000 pounds, more or less, per pound	04½	90 00	04	80 00
	....	8,892 55	....	8,106 75

* Contract awarded, subject to approval of the Chief of Engineers.

Contract entered into with John Stang, dated July 21, 1884; completed September 30, 1884.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 20, 1885.

SIR: In the last Annual Report of this office reference is made (page 316) to a plan suggested by the officer in charge of the improvement of the harbor of Cleveland, Ohio, for closing the eastern side of the breakwater, now nearly completed, at that place, by another exterior lake-arm instead of by extending the east pier of entrance as originally proposed; and in my letter of November 19 last, I had the honor to submit for your consideration the report of the Board of Engineer Officers, constituted to examine and report upon this subject.

The conclusions of the Board, with the suggestions of this office thereon, were approved by you, but since no change in the plan already adopted, and upon which the improvement is now in progress, can be made without the sanction of Congress, I beg leave to suggest that the accompanying copies of my letter of November 19, and of the report of the Board be transmitted to the Speaker of the House of Representatives for the information and favorable consideration of the Committee on Rivers and Harbors.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

HON. ROBERT T. LINCOLN,
Secretary of War.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., November 19, 1884.

SIR: The accompanying report of the Board of Engineers, constituted by your direction by Special Order No. 98, current series, from this office, to consider and report upon a project submitted by Maj. L. C. Overman, Corps of Engineers (the officer in charge), for a change of the plan heretofore adopted for the harbor of refuge at Cleveland, Ohio, is respectfully submitted.

The plan now being executed and partially completed provides for a breakwater on the western side of the entrance to the harbor, and was adopted by the Secretary of War upon the recommendation of the Chief of Engineers, June 26, 1875. This breakwater has been and is of great value to navigation, but it is found during heavy gales from the northwest, that it is not always possible for vessels to enter the harbor because the current produced by winds from that quarter tends to carry them into the rough water to the eastward of east pier of entrance, where they are in danger of being wrecked.

With a view to remedying this evil, and at the same time extending the limits of the harbor of refuge, Major Overman submitted a project for an additional breakwater to the eastward of the entrance, and upon this project the Board of Engineers has submitted its report. While not adopting the line of breakwater proposed by Major Overman, the Board adopts the project of an east breakwater upon the location described in the accompanying map, at an estimated cost of $500,000.

The Board also recommends the construction of a parapet about 4 feet high and 16 feet wide on the present west breakwater, at an estimated cost of $60,000, to prevent the pouring over into the harbor of refuge of the large volume of water thrown therein during heavy gales.

I approve the portion of the report of the Board referred to above with the suggestion, however, that the proposed east breakwater be made more salient towards the lake, with the view to preventing the accumulated wave spoken of by the Board. It is probable, also, that a spur may become necessary at the west end of the structure.

The matter of a harbormaster and a tug for use of vessels entering the harbor is a subject for the local authorities to consider, or for the action of Congress.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

HON. ROBERT T. LINCOLN,
Secretary of War.

[First indorsement.]

Approved.
By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT, *November* 22, 1885.

REPORT OF BOARD OF ENGINEERS.

From the information laid before the Board by members of the Cleveland Board of Trade, the Ship-Owners' Association, and others, it appears that while the construction of the west breakwater at Cleveland, Ohio, has formed a harbor of refuge there of great value to navigators, still, during heavy gales from the northwest it is not always possible for vessels seeking the port to obtain immediate shelter under the lee of the breakwater, because the current produced by these winds tends to carry them into the rough water to the eastward of the east pier, where they are in danger of being wrecked, unless rescued by steam-tugs, which are not always available for the purpose, and even when available, are not always of sufficient power to give the aid required.

The present scheme for the completion of the harbor provides for the extension of the east pier to a point abreast of the eastern end of the west breakwater and 350 feet from it. While this scheme secures a good entrance for vessels in most conditions of wind and weather, it affords no help to those which, missing the entrance by accident, are driven to leeward, where they are almost certain to go ashore.

The change of plan proposed by Major Overman, upon which we are required to report, consists essentially in omitting the proposed extension of the east pier and in building instead of it an eastern breakwater detached from the shore, leaving between the two breakwaters an opening wide enough to serve as an entrance for vessels in all states of the weather.

The Board is of the opionion that the proposed change is one that will add materially to the value of this harbor as a harbor of refuge, by providing a shelter behind the east breakwater for vessels which, after passing the eastern end of the west breakwater, may be carried to leeward as before described, and that the change ought to be made.

In regard to the plan on which such a work should be built, it is desirable that it should be such as to cover the largest possible amount of room for anchorage and for handling vessels, and that its outline and position should be such as to guard the entrance from the dangerous cumulative wave to which it would be exposed during easterly gales were a long, straight breakwater to be built there.

The position of the west breakwater now constructed fixes the distance from the shore, beyond which the proposed east breakwater cannot be carried without impairing the value of the harbor as a harbor of refuge.

With this as one limit the greatest amount of room for anchorage would be secured by constructing the east breakwater on the prolongation of the lake-arm of the west breakwater, but the necessity for preventing the formation of the dangerous wave before referred to forbids the adoption of this line.

The Board is of the opinion that a sufficient amount of room and the necessary protection will be obtained by giving to the new work a broken outline convex towards the lake; and that the remedy for the obstruction of the harbor now complained of, caused by vessels anchoring where they please, and in such a way as to hamper the movements of those that follow them, and so as to endanger them, is to be found in the employment of a harbormaster authorized to enforce his orders and furnished with a sea-going tug.

For these reasons it recommends that the east breakwater be built about on the following lines, as indicated on the tracing returned with

Major Overman's letter of May 26, the positions and lengths being regarded as approximate:

Beginning at a point on the prolongation of the lake-arm of the west breakwater and 500 feet from it, and running 500 feet on that prolongation; then inclining towards the shore about 20 degrees and running 1,000 feet in that direction; then running on a course parallel to that proposed by Major Overman 2,000 feet further, stopping in a depth of about 25 feet water, about 2,600 feet from the shore, leaving between its eastern end and the 14-foot curve an entrance about 1,200 feet wide. The cross-section of the new work should be about the same as that of the west breakwater.

Such a breakwater would give an increased area for anchorage between it and the 14-foot curve of about 120 acres during northwest gales, and about 70 acres during northeast gales. It would protect the present harbor on the west side during easterly gales, and would afford safe and convenient anchorage for vessels running into the harbor during westerly gales.

The Board also recommends the construction of a parapet about 4 feet high and 16 feet wide on the present west breakwater, to prevent the pouring over into the harbor of the large volume of water thrown therein during heavy gales, which it is asserted raises the level of the water within the harbor to such an extent as to produce a very strong current out of it at the entrance.

The cost of such a parapet would probably be about	$60,000
The cost of the proposed east breakwater, 3,500 feet long, would be about	440,000
Total	500,000

The estimated cost of this harbor of refuge as originally projected and approved was $1,800,000.

The amount expended up to the present time, the west breakwater being completed as originally designed, is $800,000.

If the work now recommended be constructed, the total cost of the harbor of refuge under the project now submitted will be about $1,300,000, which is $500,000 less than the original estimate.

The Board further recommends, in order that the present harbor may completely fulfill the object for which it was constructed, that a harbor-master be appointed, and that a strong sea-going tug be employed during the season of navigation to tow in and place vessels which cannot be handled by the river tugs.

Respectfully submitted.

WALTER MCFARLAND,
Lieut. Col. of Engineers.
JOHN M. WILSON,
Lieut. Col. of Engineers, Bvt. Colonel, U. S. A.
L. COOPER OVERMAN,
Major of Engineers.

M M 11.

IMPROVEMENT OF FAIRPORT HARBOR, OHIO.

Grand River rises in the northeastern part of Ohio, and after a very circuitous course empties into Lake Erie at a point about midway between its eastern and western extremities.

A full description of the operations carried on for the improvement of this harbor during the past fifty-five years will be found in Annual Report for 1880 and 1881.

The project of improvement adopted in 1825, when the mouth of the river was closed by a sand-bar so hard and dry in summer that teams could drive across, and which project has been amended from time to time since that date, as the demands of commerce called for an increased depth of water, provides for parallel piers 200 feet apart, running out from each side of the entrance to a depth of 16 feet in the lake.

OPERATIONS DURING THE FISCAL YEAR.

Balance on hand at beginning of fiscal year was only $425.08. No work was in progress. The act of July 5, 1884, appropriated $10,000 for this harbor, which it was decided to expend in extension of the east pier in dredging and in repairs to piers.

A contract was made, dated October 9, 1884, with Courtland D. Merry, of Burg Hill, Ohio, for extension of pier and repairs to piers.

Two lettings were had for proposals for dredging, but all bids were rejected as too high. In May, 1885, bids were invited by circular letter and an agreement entered into with W. E. Rooney, of Toledo, Ohio, to excavate about 10,000 cubic yards, at 23¾ cents per cubic yard. Dredge operations were commenced May 25, and completed June 25, 1885; a total of 10,082 cubic yards were removed from channel at end of piers, and from the bars in lake beyond end of piers, and resulted in restoring a good 16-foot channel between piers, and a good 15½-foot channel through bars in lake at entrance to harbor.

Work, under contract with Courtland D. Merry, was not begun until April 9 1885, although the contractor was advised to begin the construction of his cribs much earlier. The work has made very poor progress, and by June 20, 1885, the date mentioned for completion of the contract, not one-third had been accomplished. An extension until July, 31, 1885, was asked for and obtained, the favor being granted, not as deserved, but because no serious disadvantage had been occasioned by the delay.

During the fiscal year the sum of $4,337.76 has been expended and it is expected that the balance of the appropriation of July 5, 1884, will be exhausted by August 1, 1885.

Up to the close of the fiscal year the sum of $237,670.49 has been appropriated for this harbor, of which sum $231,583.17 has been expended.

The present project provides for an extension of *both* piers, for repairs and for dredging, so as to obtain and maintain a good channel 16 feet deep and 200 feet wide from the lake to railroad docks near mouth of river. The estimated cost is $93,000, of which sum $43,000 have been appropriated and $30,000 can be expended during the fiscal year ending June 30, 1887.

At the close of the fiscal year there was a good channel of 16 feet depth around the bar, and to the west of the northerly line of entrance to the harbor, while in the direct channel there is but 15½ feet depth. Between the piers there was a good 16 feet channel.

Fairport Harbor is in the collection district of Cuyahoga, Ohio.

There is a fixed white-light of the third order on shore and a beacon on the east pier.

The value of the imports for the season of 1884 was $192,532.

The collector failed to estimate the value of the exports, also to report the amount of revenue collected.

Forty vessels (engaged in the coasting trade), with an aggregate tonnage of 16,014 tons, entered, and twenty-five vessels, with an aggregate tonnage of 12,209 tons, cleared during season of 1884. One vessel (engaged in the foreign trade), of 83 tons, entered and cleared during season of 1884.

Money statement.

July 1, 1884, amount available		$425 08
Amount appropriated by act approved July 5, 1884		10,000 00
		10,425 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$4,226 57	
July 1, 1885, outstanding liabilities	111 19	
		4,337 76
July 1, 1885, amount available		6,087 32
Amount (estimated) required for completion of existing project		50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging 15,000 *cubic yards, more or less, of mud, clay, sand, &c., from the channel at the entrance to Fairport Harbor, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at* 12 *o'clock noon, Monday, August* 25, 1884, *under advertisement of August* 9, 1884.

No.	Names and addresses of bidders.	Rate per cubic yard.	Remarks.
		Cents.	
1	Jesse Sims, Cleveland, Cuyahoga County, Ohio.	35	Price considered too high. Recommend that the bid be rejected and new letting be made.
2	L. P. & J. A. Smith, Cleveland, Cuyahoga County, Ohio.	38½	

Abstract of proposals for dredging 15,000 *cubic yards, more or less, of mud, clay, sand, &c., from the channel at the entrance to Fairport Harbor, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at* 12 *o'clock noon, Monday, September* 15, 1884, *under advertisement of August* 30, 1884.

No.	Names and address of bidders.	Rate per cubic yard.	Remarks.
		Cents.	
1	L. P. & J. A. Smith, Cleveland, Cuyahoga County, Ohio.	38	Proposal considered too high. Recommend that it be rejected and letting made in early spring of 1885.

Abstract of proposals for constructing 80 linear feet, more or less, of pier, and making general repairs to piers at Fairport Harbor, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at 12 o'clock noon, Saturday, September 20, 1884, under advertisement of August 20, 1884.

No.	Names and addresses of bidders.	Materials.	Amount.
*1	Daniel E. Bailey, Buffalo, N. Y.	74,952 feet B. M., more or less, hemlock timber and plank, at $21 per M feet B. M.	$1,573 99
		59,393 feet B. M., more or less, white-pine timber and plank: 35,582 feet B. M., at $29, and 23,811 feet B. M. at $50 per M feet B. M.	2,222 43
		3,101 feet B. M., more or less, oak timber: 1,920 feet B. M., at $40, and 1,181 feet B. M., at $50 per M feet B. M.	135 85
		1,051 linear feet, more or less, white oak piles, including driving and cutting off, at 35 cents per linear foot.	367 85
		128, more or less, treenails, at $5 per hundred	6 40
		1,200 pounds, more or less, screw and washer bolts, at 3 cents per pound.	36 00
		5,400 pounds, more or less, drift-bolts, at 3 cents per pound.	162 00
		1,200 pounds, more or less, boat spike, at 3 cents per pound.	36 00
		350 cords, more or less, stone for filling and foundation, at $7 per cord.	2,450 00
		500 cubic yards, more or less, dredging, at 50 cents per cubic yard.	250 00
			7,240 52
2	McKenzie & Barrett, Ashtabula, Ohio.	74,952 feet B. M., more or less, hemlock timber and plank, at $23.75 per M feet B. M.	1,780 11
		59,393 feet B. M., more or less, white pine timber and plank, at $33.75 per M feet B. M.	2,004 51
		3,101 feet B. M., more or less, oak timber, at $40 per M. feet B. M.	124 04
		1,051 linear feet, more or less, white oak piles, including driving and cutting off, at 46 cents per linear foot.	483 46
		128, more or less, treenails, at $6.50 per hundred....	8 32
		1,200 pounds, more or less, screw and washer bolts, at 7½ cents per pound.	90 00
		5,400 pounds, more or less, drift-bolts, at 7½ cents per pound.	405 00
		1,200 pounds, more or less, boat spike, at 7½ cents per pound.	90 00
		350 cords, more or less, stone for filling and foundations, at $9.75 per cord.	3,412 50
		500 cubic yards, more or less, dredging, at 80 cents per cubic yard.	400 00
			8,797 94
†3	Courtland D. Merry, Burg Hill, Ohio.	74,952 feet B. M., more or less, hemlock timber and plank, at $19.50 per M feet B. M.	1,461 56
		59,393 feet B. M., more or less, white pine timber and plank, at $24 per M feet B. M.	1,425 43
		3,101 feet B. M., more or less, oak timber, at $25 per M feet B. M.	77 52
		1,051 linear feet, more or less, white oak piles, including driving and cutting off, at 33 cents per linear foot.	346 83
		128, more or less, treenails, at $2.50 per hundred....	3 20
		1,200 pounds, more or less, screw and washer bolts, at 3½ cents per pound.	42 00
		5,400 pounds, more or less, drift-bolts, at 3½ cents per pound.	189 00
		1,200 pounds, more or less, boat spike, at 3½ cents per pound.	42 00
		350 cords, more or less, stone for filling and foundation, at $6 per cord.	2,100 00
		500 cubic yards, more or less, dredging, at 40 cents per cubic yard.	200 00
			5,887 54

* Quantities of pine and oak divided as per terms of bid, and total obtained accordingly.

† The lowest bid. Guarantee not strictly formal. Responsibility unknown. Recommend the contract be awarded in compliance with law, provided party can satisfy the engineer in charge as to responsibility and ability.

Abstract of proposals for constructing 80 *linear feet, more or less, of pier, &c.*—Continued.

No.	Names and addresses of bidders.	Materials.	Amount.
*4	L. P. & J. A. Smith, Cleveland, Ohio	74,952 feet B. M., more or less, hemlock timber and plank, at $22 per M feet B. M.	$1,648 94
		59,393 feet B. M., more or less, white pine timber and plank, at $29 per M feet B. M.	1,722 40
		3,101 feet B. M., more or less, oak timber, at $35 per M feet B. M.	108 53
		1,051 linear feet, more or less, white oak piles, including driving and cutting off, at — per linear foot.	....
		128, more or less, treenails, at $5 per hundred	6 40
		1,200 pounds, more or less, screw and washer bolts, at 4½ cents per pound.	54 00
		5,400 pounds, more or less, drift-bolts, at 3 cents per per pound.	162 00
		1,200 pounds, more or less, boat spike, at 3½ cents per pound.	42 00
		350 cords, more or less, stone for filling and foundation, at $7.50 per cord.	2,625 00
		500 cubic yards, more or less, dredging, at 48 cents per cubic yard.	240 00
			(6,914 06) 6,609 27
†5	John Stang, Lorain, Ohio ..	74,952 feet B. M., more or less, hemlock timber and plank, at $22 per M feet B. M.	1,648 94
		59,393 feet B. M., more or less, white pine timber and plank, at $30 per M feet B. M.	1,781 79
		3,101 feet B. M., more or less, oak timber, at $30 per M feet B. M.	93 03
		1,051 linear feet, more or less, white oak piles, including driving and cutting off, at 29 cents per linear foot.	304 79
		128, more or less, treenails, at $4 per hundred.... ..	5 12
		1,200 pounds, more or less, screw and washer bolts, at 4 cents per pound.	48 00
		5,400 pounds, more or less, drift-bolts, at 2½ cents per pound.	135 00
		1,200 pounds, more or less, boat spike, at 3 cents, per pound.	36 00
		350 cords, more or less, stone for filling and foundation, at $6 per cord.	2,100 00
		500 cubic yards, more or less, dredging, at 50 cents per cubic yard.	250 00
			6,402 67

* No price bid for piles. Total in parenthesis obtained by taking lowest price for piles of the other, four bids, viz, 29 cents, to compare bids.

† The lowest satisfactory bid.

Contract entered into with Courtland D. Merry, dated October 9, 1884.

Abstract of letters received at United States engineer office, Cleveland, Ohio, up to and including the hour of 5 *p. m., Monday, May* 11, 1885, *in response to circular letter from Maj. L. Cooper Overman, Corps of Engineers, dated May* 4, 1885, *calling for price per cubic yard for removing about* 10,000 *cubic yards of mud, clay, sand, &c., from off the bar in lake, beyond end of piers at Fairport Harbor, Ohio.*

No.	Names and addresses of bidders.	Price per cubic yard.	Remarks.
		Cents.	
1	Jesse Sims, Cleveland, Ohio	30	
2	W. E. Rooney, Toledo, Ohio	23.875	Respectfully recommended that the work be given to W. E. Rooney, at price bid, and that he be authorized to begin work at once.
3	Hingston & Woods, Buffalo, New York......... .. .	28	
4	Stang & Gillmore, Lorain, Ohio	29	
5	L. P. & J. A. Smith, Cleveland, Ohio..................	25.5	
6	Fitzsimmons & Connell, Chicago, Ill	(*)	
7	Sheldon & Buck, Toledo, Ohio	(*)	
8	William Richardson, Buffalo, N. Y	(*)	
9	E. H. French, Toledo, Ohio	(*)	
10	J. Louis Linn, Erie, Pa	(*)	
11	Chicago Dredging and Dock Company, F. Davis, superintendent, Chicago, Ill.	(*)	

* No price offered.

M M 12.

IMPROVEMENT OF ASHTABULA HARBOR, OHIO.

The original project for the improvement of this harbor was adopted in 1826, at which time there was a depth of only 2 feet of water on the bar; this project has been modified from time to time in order to meet the demands of commerce and increased draught of vessels navigating the lakes; it provided for piers running out into the lake to 12 feet depth, whereas the present design is to carry them out to 16 feet depth. The piers at shore are 160 feet apart, but approach each other lakeward and were only 100 feet apart 900 feet off shore; then the west one flared to the westward in the next 200 feet, and at 1,100 feet off shore they were again 160 feet apart. From this point outward the piers are parallel. Before operations were commenced rock was encountered at 7 to 9 feet under the water-surface, extending across the channel in the form of a wide reef, which required blasting and dredging for its removal in order to secure the present depth of 15½ to 16 feet.

The present project was continued during the fiscal year under appropriation of July 5, 1884. Capt. Edward Maguire, Corps of Engineers, was in charge of the work until March 9, 1885, when he was relieved by me in compliance with letter from the Chief of Engineers, United States Army, dated July 12, 1885, Washington, D. C.

OPERATIONS FOR THE FISCAL YEAR.

At the beginning of the fiscal year there was no contract in force nor any work in progress. The act of July 5, 1884, appropriated the sum of $22,500 for this work. The then officer in charge submitted project to expend part of said sum in tearing out part of old pier, in building 280 linear feet of crib-work to extend the west pier, shoreward, to do some dredging and to construct 220 linear feet of shore-protection. This was approved and a contract was made with McKenzie and Barrett, of Ashtabula, Ohio, dated October 13, 1884, to do the above work. Operations were commenced in October and continued until bad weather interrupted the work in December. During this time 197 linear feet of old pier were removed, 222 linear feet of shore-protection were constructed, and about one-half of the dredging contemplated under this contract was accomplished. Operations were resumed in April by McKenzie & Barrett, and by the end of the fiscal year their contract was completed. In addition to the fall work they removed 273 linear feet of the old pier, constructed seven cribs 40 feet long, 10 feet wide, and from ten to eleven courses in height, sunk the same on rock-bottom, filled same with stone and built superstructure over same and filled it with stone. With this work the west pier was extended shoreward 282½ linear feet. They also removed 7,878 cubic yards "place measurement," of material from channel and from bank in rear of old pier.

The total amount paid under this contract was $13,609.94. In May, 1885, some vessels entering the harbor were grounded on the shoal between piers; as the spring navigation had opened and large trade expected at this harbor in iron ore and coal, the railroad companies were very anxious to have some dredging done at once. Authority was obtained to make terms at the most favorable rates for the dredging required. An agreement was accordingly made with Stang & Gillmore, of Lorain, Ohio, to do the work required at 18 cents per cubic yard, scow-measurement, for dredging outside of piers, and at 20 cents per cubic yard, place measurement, for all dredging inside the piers. Work was commenced June 2, and completed July 9, 1885. A total of 9,295 cubic yards were removed, of which 4,664 cubic yards (place measurement) were removed from between the piers, and 4,631 cubic yards (scow measurement) were taken from outside the end of piers and off bars in lake, at entrance to harbor. The amount expended under the above agreement was $1,766.38.

With the dredging done under the contract of McKenzie & Barrett, and under agreement with Stang & Gilmore, the channel was left in good condition with from 15½ to 16 feet depth of water between piers, and from deep water in lake to entrance of piers.

A slight shoal with 15½ feet of water was left in channel between piers where rock-bottom was found at that depth.

The total amount expended during the fiscal year was $10,046.99.

Some slight repairs by hired labor were made to shore-protection, and to the east pier near its connection with the shore.

In May, advertisement was made for proposals for continuing the widening of the channel by tearing out old pier, dredging bank to rock-bottom, and revetting the new bank with timber construction; a contract was made for the above with L. P. & J. A. Smith, of Cleveland, Ohio, dated June 20, 1885, and work was to begin July 5, 1885.

By the end of November the remainder of the appropriation of July 5, 1884, will be expended under said contract in accordance with the existing project.

The total amount appropriated for this harbor up to the close of fiscal year ending June 30, 1885, is $372,401.21, of which sum $357,252.78 have been expended.

Ashtabula Harbor is in the collection district of Cuyahoga, Ohio. There is a fixed white light of the fifth order, varied by flashes, on the west pier. Fort Porter, N. Y., 120 miles distant, is the nearest work of defense. The value of the imports for the season of 1884 was $4,208,213, and of the exports $360,699.

The collector reports that in addition to the exports heretofore given, that 182,753 tons of coal were shipped, but does not state its value. The collector failed to report the amount of revenue collected.

Five hundred and eighty-four vessels (engaged in the coasting trade), with an aggregate tonnage of 407,087 tons, entered, and five hundred and eighty-six vessels, with an aggregate tonnage of 407,138 tons, cleared, during season of 1884.

Thirty vessels (engaged in the foreign trade), with an aggregate tonnage of 8,419 tons, entered, and ninety-nine vessels, with an aggregate tonnage of 47,686 tons, cleared, during season of 1884.

Money statement.

July 1, 1884, amount available		$2,695 42
Amount appropriated by act approved July 5, 1884		22,500 00
		25,195 42
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$10,046 99	
July 1, 1885, outstanding liabilities	1,186 03	
		11,233 02
July 1, 1885, amount available		13,962 40
Amount (estimated) required for completion of existing project		80,250 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		77,550 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

act of proposals for widening and deepening the channel at Ashtabula Harbor, Ohio, eived and opened at United States engineer office, Buffalo, N. Y., at 11 o'clock a. m. th meridian time), September 23, 1884, under advertisement of August 23, 1884.

[Approximate quantities.]

Names and ad- lresses of bidders.	Names and addresses of guarantors.	Materials.	Amount.
ouis P. Smith and James A. Smith, Cleveland, Ohio.	Patrick Smith and James Cunnea, Cleveland, Ohio.	Removing old pier, 570 linear feet, at $12 per linear foot.	$6,840
		Dredging 14,500 cubic yards, at 75 cents per cubic yard.	10,875
		Hemlock, 90,000 feet, B. M., at $22 per M feet.	1,980
		White pine, 40,000 feet, B. M., at $31 per M feet.	1,240
		White oak, 3,400 feet, B. M., at $35 per M feet.	119
		Stone filing, 190 cords, at $7 per cord.	1,330
		Bolts, screws, and washers, 4,000 pounds, at 4 cents per pound.	160
		Drift-bolts, 13,000 pounds, at 3 cents per pound.	390
		Spike, 900 pounds, at 3 cents per pound.	27
		Shore protection, 220 linear feet, at $5 per linear foot.	1,100
		Mattress work, 50 linear feet, at $5 per linear foot.	250
			24,311
lonzo F. McKenzie, and Charles H. Barrett, Ashtabula, Ohio.	Luban B. Sherman, and Potius S. Kelper, Ashtabula, Ohio.	Removing old pier, 570 linear feet, at $4 per linear foot	2,280
		Dredging 14,500 cubic yards, at 20 cents per linear yard.	2,900
		Hemlock, 90,000 feet, B. M., at $21.50 per M feet.	1,935
		White pine, 40,000 feet, B. M., at $29.50 per M feet.	1,180
		White oak, 3,400 feet, B. M., at $40 per M feet.	136
		Stone filling, 190 cords, at $7.50 per cord.	1,425
		Bolts, screws, and washers, 4,000 pounds, at 4½ cents per pound.	180
		Drift-bolts, 13,000 pounds, at 4 cents per pound.	520
		Spike, 900 pounds, at 5 cents per pound.	45
		Shore protection, 220 linear feet, at $7.50 per linear foot.	1,650
		Mattress work, 50 linear feet, at $12.80 per linear foot.	640
			12,891
Daniel E. Bailey, Buffalo.	David S. Bennett and Robert M. Cannon, Buffalo.	Removing old pier, 570 linear feet, at $5 per linear foot.	2,850
		Dredging 14,500 cubic yards, at 50 cents per cubic yard.	7,250
		Hemlock, 90,000 feet, B. M., at $22 per M feet.	1,980
		White pine, 40,000 feet, B. M., at $30 per M feet.	1,200
		White oak, 3,400 feet, B. M., at $35 per M feet.	119
		Stone filing, 190 cords, at $7,50 per cord.	1,425
		Bolts, screws, and washers, 4,000 pounds, at at 3 cents per pound.	120
		Drift-bolts, 13,000 pounds, at 3 cents per pound.	390
		Spike, 900 pounds, at 3 cents per pound.	27
		Shore protection, 220 linear feet, at $7 per linear foot.	1,540
		Mattress work, 50 linear feet, at $12 per linear foot.	600
			17,501

west bid. No seals to signatures of bidders on one of the proposals. Christian name of Barot written out in full.

Abstract of proposals, for widening and revetting the channel at Ashtabula Harbor, Ohio, received and opened by Maj. L. Cooper Overman, Corps of Engineers, at United States engineer office, Cleveland, Ohio, at 12 *o'clock noon, Monday, June* 15, 1885, *under advertisement of May*, 15, 1885.

[Approximate quantities.]

No.	Names and addresses of bidders.	Materials.	Amount.
1	Edward J. Hingston and Arthur Woods, Buffalo, N. Y.	Removing old pier, 460 linear feet, at $3.90 per linear foot.	$1,794 00
		Dredging 9,500 cubic yards, at 20 cents per cubic yard.	1,900 00
		Hemlock, 33,000 feet B. M., at $21 per M feet B. M....	693 00
		White pine, 22,180 feet B. M., at $30 per M feet B. M.	665 40
		White oak, 14,400 feet B. M., at $33 per M feet B. M.	475 20
		Stone filling, 100 cords, at $8 per cord of 128 cubic feet.	800 00
		Screw and washer bolts, 4,000 pounds, at 4 cents per pound.	160 00
		Drift-bolts, 1,800 pounds, at 3½ cents per pound......	63 00
		Spike, 1,200 pounds, at 3½ cents per pound	42 00
		Catch-sand fence, 680 linear feet, at $2.50 per linear foot.	1,700 00
		Mattress work, 50 linear feet, at $12 per linear foot..	600 00
		Handling required of United States stone, 300 cords, at $3 per cord.	900 00
			9,792 60
2	Alonzo F. McKenzie, Ashtabula, Ohio.	Removing old pier, 460 linear feet at, $3.50 per linear feet.	1,610 00
		Dredging 9,500 cubic yards, at 19 cents per cubic yard.	1,805 00
		Hemlock, 33,000 feet B. M., at $26.50 per M feet B. M	874 50
		White pine, 22,180 feet B. M., at $32.50 per M feet B. M.	720 85
		White oak, 14,400 feet B. M., at $34 per M feet B. M.	489 60
		Stone filling, 100 cords, at $7.50 per cord of 128 cubic feet.	750 00
		Screw and washer bolts, 4,000 pounds, at 5 cents per pound.	200 00
		Drift-bolts, 1,800 pounds, at 4 cents per pound.......	72 00
		Spike, 1,200 pounds, at 5 cents per pound	60 00
		Catch-sand fence, 680 linear feet, at $1.40 per linear foot.	952 00
		Mattress work, 50 linear feet, at $10 per linear foot..	500 00
		Handling required of United States stone, 300 cords, at $4.50 per cord.	1,350 00
			9,383 95
*3	Louis P. Smith and James A. Smith, Cleveland, Ohio.	Removing old pier, 460 linear feet, at $8.50 per linear foot.	3,910 00
		Dredging 9,500 cubic yards, at 15 cents per cubic yard.	1,425 00
		Hemlock, 33,000 feet B. M., at $18.00 per M feet B. M.	594 00
		White pine, 22,180 feet B. M., at $26 per M feet B. M.	576 68
		White oak, 14,400 feet B. M., at $28 per M feet B. M.	403 20
		Stone filling, 100 cords, at $6 per cord of 128 cubic feet.	600 00
		Screw and washer bolts, 4,000 pounds, at 3½ cents per pound.	140 00
		Drift-bolts, 1,800 pounds, at 3 cents per pound.......	54 00
		Spike, 1,200 pounds, at 4 cents per pound............	48 00
		Catch-sand fence, 680 linear feet, at $1.48 per linear foot.	1,006 40
		Mattress work, 50 linear feet, at $6 per linear foot...	300 00
		Handling required of United States stone, 300 cords, at $1 per cord.	300 00
			9,357 28
4	John Stang and Quartus Gillra in, Ohio.	Removing old pier, 460 linear feet, at $2.40 per linear foot.	1,104 00
		Dredging 9,500 cubic yards, at 12½ cents per cubic yard.	1,187 50
		Hemlock, 33,000 feet B. M., at $19.50 per M feet B. M.	643 50
		White pine, 22,180 feet B. M., at $27.50 per M feet B. M.	609 95

* Lowest bid. Parties responsible. Reccommend that the contract be awarded on this bid.

Abstract of proposals for widening and revetting the channel at Ashtabula Harbor Ohio, &c.—Continued.

No.	Names and addresses of bidders.	Materials.	Amount.
4	John Stang and Quartus Gillmore, Lorain, Ohio.	White oak, 14,400 feet B. M., at $30 per M feet B. M.	$432 00
		Stone filling, 100 cords, at $5.40 per cord of 128 cubic feet.	540 00
		Screw and washer bolts, 4,000 pounds, at 4 cents per pound.	160 00
		Drift bolts, 1,800 pounds, at 2 cents per pound	36 00
		Spike, 1,200 pounds, at 3 cents per pound	36 00
		Catch-sand fence, 680 linear feet, at $14 per linear foot.	9,520 00
		Mattress work, 50 linear feet, at $4 per linear foot	200 00
		Handling required of United States stone, 300 cords, at $5 per cord.	1,500 00
			15,[illegible]

Abstract of contracts for improving harbor at Ashtabula, Ohio, in force, during fiscal year ending June 30, 1885.

Names and residences of contractors.	Date of contract.	Subject of contract.	Removing old pier, per linear foot.	Dredging, per cubic yard.	Hemlock, per M feet, B. M.	White pine, per M feet, B. M.	White oak, per M feet, B. M.
McKenzie & Barrett, Ashtabula, Ohio.*	Oct. 13, 1884	Widening and deepening channel.	$4 00	$0 20	$21 50	$29 50	$40 00
L. P. & J. A. Smith, Cleveland, Ohio.	June 25, 1885	Widening and revetting channel.	8 50	0 15	18 00	26 00	28 00

Names and residences of contractors.	Stone-filling, per cord of 128 cubic feet.	Screw and washer-bolts, per pound.	Drift-bolts, per pound.	Spike, per pound.	Shore protection, per linear foot.	Matress work, per linear foot.	Catch-sand fence, per linear foot.	Handling required of United States stone, per cord of 128 cubic feet.
McKenzie & Barrett, Ashtabula, Ohio.*	$7 50	$0 4½	$0 04	$0 05	$7 50	$12 80	....	....
L. P. & J. A. Smith, Cleveland, Ohio.	6 00	0 3½	0 03	0 04	....	6 00	$1 48	$1 [illegible]

*Contract completed and closed June 30, 1885.

M M 13.

IMPROVEMENT OF CONNEAUT HARBOR, OHIO.

No work was done at this harbor during the last three fiscal years ending June 30, 1885. None is contemplated this season, as there are no funds available.

The annual report for the fiscal year ending June 30, 1884, of my predecessor on this work, Capt. Edward Maguire, Corps of Engineers, whom I relieved March 9, 1885, is so much in accordance with my own views that I can but quote from it. He quoted as follows, from his predecessor's report:

> The project for the improvement of this harbor was adopted in 1829, and the bar at the mouth of Conneaut Creek was dry at low stages of water, when the original improvements were commenced. Operations were carried on during the years of 1829 to 1832, and from 1836 to 1838, inclusive, which comprised the construction of piers, 125 feet apart, running out from shore to a depth of 12 feet of water in the lake, and dredging; the design was to afford a depth of 12 feet of water through the bar and into Conneaut Creek, the harbor of Conneaut.
>
> Works of improvement have progressed with more or less interruptions and suspensions, no work having been done from 1832 to 1836, from 1839 to 1844, from 1845 to 1852, from 1852 to 1866, and none last year or this. The best channel depth ever obtained at the entrance was only 11 feet, the more usual depth being from 8 to 9 feet, and the commerce of the port has always been trifling; we may therefore say the hopes entertained for this harbor when its improvement was undertaken have never been realized.
>
> It has been recommended that improvements should be made at this harbor as follows:
>
> | | |
> |---|---|
> | Renewing 800 feet of old east pier, at $30 per foot | $24,000 |
> | Rebuilding 790 feet of superstructure, west pier, at $10 per foot | 7,900 |
> | Contingencies, 10 per cent | 3,190 |
> | Total | 35,090 |
>
> I have nothing to add to this recommendation; indeed, it seems to me that unless the facilities for transportation by land to and from this harbor should be materially augmented, any outlay for the improvement of the harbor is injudicious; considerable sums have been expended during the last fifty years in preserving the harbor and its improvements without drawing private or incorporate enterprise in its direction; therefore the harbor must be regarded as of questionable advantage as a commercial outlet to and from the lake.

The total amount appropriated for this harbor up to the close of the present fiscal year was $112,629.39, of which amount $112,623.28 have been expended.

The estimated cost of completing the existing project is $35,090, which amount could be expended during the fiscal year ending June 30, 1887, for objects in accordance with the estimate quoted above.

Conneaut is in the collection district of Cuyahoga, Ohio; there is a fixed white light of the sixth order at the end of the west pier. Fort Porter, N. Y., 105 miles distant, is the nearest work of defense.

The amount of revenue collected during the eleven months ending May 31, 1885, was $15.95.

The value of the imports during the eleven months ending May 31, 1885, was $80; and of the exports, $125. Ten vessels with an aggregate tonnage of 360 tons entered, and twelve vessels with an aggregate tonnage of 395 tons, cleared, during eleven months ending May 31, 1885. The deepest draught of any vessel entering or leaving the harbor was 6¼ feet.

The deputy collector reports the value of the fishing interests at Conneaut Harbor, viz, three steamers and eight sail-boats, at about $15,000.

Money statement.

July 1, 1884, amount available	$19 68
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	13 57
July 1, 1885, amount available	6 11

Amount (estimated) required for completion of existing project	$35,000
Amount that can be profitably expended in fiscal year ending June 30, 1887	35,000

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

M M 14.

IMPROVEMENT OF DUNKIRK HARBOR, NEW YORK.

The improvement of this harbor was commenced in 1827, when the first appropriation therefor was made. The original project was much the same as that of the existing improvement, which comprises the formation of an artificial harbor in front of the city by means of a breakwater, running nearly parallel with the shore, and a shore-arm or pier to the westward, with an opening between the pier and the breakwater. By 1832 the sum of $28,489.84 had been expended on the original plan, and the breakwater was then 2,564 feet long and the pier 14 feet long.

Various improvements and repairs were made from time to time, and by 1838 there had been completed 2,125 feet of breakwater and 300 feet of detached breakwater. In 1848 the breakwater was demolished. Between 1848 and 1870 some portions of the work were renewed and others repaired, but in 1870 a Board of engineers took into consideration the question of the radical improvement of the harbor. The Board recommended a plan which provided a breakwater 2,860 feet long, one part of which, 2,300 feet in length, was to be nearly parallel with the shore, the other part to be nearly parallel to the axis of the channel entrance, 560 feet long, and terminating at the position of the dumb beacon. Of the 2,300-foot section 1,341 feet have been completed; none of the 560-foot section has been built.

OPERATIONS DURING THE FISCAL YEAR.

At the beginning of the fiscal year no work was in progress, as the funds on hand, $9.29, were too small for any material use.

The act of July 5, 1884, appropriated $10,000 for this harbor, and Capt. Edward Maguire, Corps of Engineers, the then officer in charge, proposed to expend this sum in dredging and some repairs to the east breakwater.

This project was approved, a contract was made dated November 29, 1884, with Hingston & Woods, of Buffalo, N. Y., for the excavation of 37,000 cubic yards, more or less, of material from channel, and the repairs to 100 linear feet of the face timbers of the east breakwater. Operations were begun with dredge May 20, 1885, and continued during the remainder of the fiscal year. During this time 13,318 cubic yards of material were excavated from main channel. The repairs of east breakwater was begun June 1, and by the close of the month the 100 linear feet of face timbers were removed and the work completed as required, except the placing of the galvanized iron caps to ends of timbers. The amount expended during the fiscal year was $1,541.89.

The total amount appropriated for this harbor to the close of the fiscal year has amounted to $459,079.38, of which sum $450,611.98 have been expended.

During the season of 1885, the balance on hand of the appropriation of July 5, 1884, will be expended mainly in dredge-work, which it is expected will give a good 13-foot depth of channel from the lake to the docks.

Very extensive rock excavation and dredging is required at this harbor to make it fulfill the requirements of the present commerce of the lakes on a scale commensurate with the plan of the Board of engineers of 1870. A 16-foot depth of channel and harbor would be required for the present class of vessels, whereas rock-bottom occurs at 12½ feet depth. Further, Dunkirk has not kept pace with many of the other harbors on Lake Erie, and it is doubtful, with a harbor improved so as to give 16 feet depth, whether trade would seek the port of Dunkirk, N. Y., to an extent that would justify the great expense necessary for such improvement.

The last project submitted for the improvement of this harbor contemplated the extension of the breakwater 560 feet parallel to the channel and 300 feet eastward parallel to the shore-line. The estimated cost was $60,200, all of which could be expended in one season. If, however, the whole sum should not be appropriated at once, then the portion of the proposed extension parallel to the *channel* should be built first.

Vesselmen frequenting this harbor make repeated inquiries as to why the day beacon is not restored at the entrance of the harbor. The old one was carried away about four years ago by the ice and has not been rebuilt. It is much needed, and its want renders the entrance so hazardous as to prevent many vessels from seeking the harbor for a refuge, which they would otherwise avail themselves of if the beacon was restored. I would therefore respectfully suggest that said day beacon be rebuilt at as early a day as is practicable.

Dunkirk Harbor, New York, is in the collection district of Dunkirk. It is lighted by a third-order, lake-coast, fixed white light, varied by white flashes, and a sixth-order, fixed white beacon light, west side of the channel entrance. The dumb beacon which was on the east side of the entrance has been carried away.

Fort Porter, 40 miles to the eastward, is the nearest work of defense.

There was no revenue collected during eleven months ending May 31, 1885.

There were no imports or exports during eleven months ending May 31, 1885.

Twenty vessels, with an aggregate tonnage of 4,508 tons, entered and 19 vessels, with an aggregate tonnage of 4,494 tons, cleared during eleven months ending May 31, 1885. The deepest draught of vessel entering or clearing was 12 feet.

Money statement.

July 1, 1884, amount available	$9 29
Amount appropriated by act approved July 5, 1884	10,000 00
	10,009 29
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,541 89
July 1, 1885, amount available	8,467 40
Amount (estimated) required for completion of existing project	60,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	60,200 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging and repairing east breakwater at Dunkirk Harbor, New York, received and opened at United States engineer office, Buffalo, N. Y., at 11 o'clock a. m. (75th meridian time), September 23, 1884, under advertisement of August 23, 1884.

[Approximate quantities.]

No.	Names and addresses of bidders.	Names and addresses of guarantors.	Material.	Amount.
1	Lewis P. Smith, Cleveland, Ohio; James A. Smith, Cleveland, Ohio.	Patrick Smith, Cleveland, Ohio; James Cunnea, Cleveland, Ohio.	Dredging, 37,000 cubic yards, at 40 cents per cubic yard.	$14,800
			Removing old work, 21,000 feet, B. M., at $10 per 1,000 feet.	210
			White oak, 23,400 feet, B. M., at $40 per 1,000 feet.	936
			Drift-bolts, 5,000 pounds, at 5 cents per pound.	250
			Sheet-iron, 100 linear feet, at $1 per linear foot.	100
	Total			16,296
2*	George Talbot, Buffalo, N. Y.	William Richardson, Buffalo; Lewis J. Bennet, Buffalo.	Dredging, 37,000 cubic yards, at 25 cents per cubic yard.	9,250
			Removing old work, 21,000 feet, B. M., at $25 per 1,000 feet.	525
			White oak, 23,400 feet, B. M., at $50 per 1,000 feet.	1,170
			Drift-bolts, 5,000 pounds, at 4 cents per pound.	200
			Sheet-iron, 100 linear feet, at $1.50 per linear foot.	150
	Total			11,295

* Lowest bid.

NOTE.—Bids rejected.

Abstract of proposals for dredging the channel and repair of east breakwater at Dunkirk New York, opened at United States engineer office, Buffalo, N. Y., November 15, 1884, at 11 o'clock a. m. (75th meridian time), under advertisement of October 15, 1884.

[Approximate quantities.]

No.	Names and addresses of bidders.	Names and addresses of guarantors.	Materials.	Amount.
1	Edward J. Hingston, Buffalo, N. Y; Arthur Woods, Buffalo, N. Y.	Charles A. Gatchell, Buffalo, N. Y.; Oliver S. Laycock, Buffalo, N. Y.	Dredging, 37,000 cubic yards, at 18 cents per cubic yard.	$6,660 00
			Removing old work, 21,000 feet B. M., at $10 per 1,000 feet.	210 00
			White oak, 23,400 feet, B. M., at $40 per 1,000 feet.	936 00
			Drift-bolts, 5,000 pounds, at 6 cents per pound.	300 00
			Sheet-iron, 100 linear feet, at 96 cents per foot.	96 00
				8,202 00
2	Louis P. Smith, Cleveland, Ohio; James A. Smith, Cleveland, Ohio.	Patrick Smith, Cleveland, Ohio; James Cunnea, Cleveland, Ohio.	Dredging, 37,000 cubic yards, at 30 cents per cubic yard.	11,100 00
			Removing old work, 21,000 feet, B. M., at $7 per 1,000 feet.	147 00
			White oak, 23,400 feet, B. M., at $40 per 1,000 feet.	936 00
			Drift-bolts, 5,000 pounds, at 5 cents per pound.	250 00
			Sheet-iron, 100 linear feet, at $1 per foot.	100 00
				12,533 00

Contract entered into with Hingston and Woods, dated November 29, 1884.

M M 15.

PRELIMINARY EXAMINATION OF THE CHANNEL KNOWN AS THE OLD "RIVER-BED" OF THE CUYAHOGA RIVER, OHIO.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
January 9, 1885.

SIR: To comply with the requirements of the river and harbor act of July 5, 1884, I have the honor to submit herewith a copy of a report to this office from Maj. L. Cooper Overman, Corps of Engineers, of a preliminary examination with the view of "opening and improving the channel known as the old river-bed of the Cuyahoga River," at Cleveland, Ohio.

Major Overman reports that, in his opinion, this is worthy of improvement, and gives his reasons therefor.

In the river and harbor act of August 2, 1882, provision was made for an examination and survey of this same locality, and the local engineer then in charge, Lieut. Col. J. M. Wilson, Corps of Engineers, reported that, in his opinion, it was worthy of improvement, but that the work was not a public necessity at this time. This report was transmitted to Congress at its last session and printed in Senate Ex. Doc. No. 30, Forty-eighth Congress, first session.

This old river-bed is now connected at its northeastern extremity with the Cuyahoga River and from thence with the lake by way of the channel through the United States piers. It forms a large and important part of the harbor of Cleveland, being lined with docks and slips and largely used for receiving and shipping coal, iron, &c. Its improvement and maintenance is in charge of the local authorities and the city annually expends quite a sum of money in deepening its channel. The tracks of the Lake Shore and Michigan Southern Railroad lie between the old river-bed and the lake.

It appears that a direct communication with the lake at the other extremity of this old channel through the railroad embankment would be a benefit to the owners of the adjacent lands and a great accommodation to vessels using this inner harbor, but it appears also that the desired improvement would be more for local convenience than for public necessity or convenience of general commerce, and hence questionable whether it should be made at the expense of the United States. The views of Major Overman are in consequence not concurred in by me and in accordance with the requirements of the act no instructions have been given to make a survey of the locality with the view of submitting an estimate for the work.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF MAJOR L. COOPER OVERMAN, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, October 18, 1884.

GENERAL: In compliance with circular letters from the office of the Chief of Engineers, dated Washington, D. C., July 31, and September

4, 1884, respectively, I have the honor to submit the following report of "preliminary examination on the opening and improving of the channel known as the old 'river-bed' of the Cuyahoga River," as provided for in section 9 of the river and harbor act of July 5, 1884.

The section of the act above mentioned reads as follows:

> That the Secretary of War is hereby directed, at his discretion, to cause examinations or surveys, or both, and estimates of cost of improvements proper to be made, at the following points namely: * * * At Cleveland, Ohio, on the opening, and improving of the channel known as the old "river-bed" of the Cuyahoga River: * * * *Provided*, That no survey shall be made of any harbors or rivers until the Chief of Engineers shall have directed a preliminary examination of the same by the local engineer in charge of the district, or an engineer detailed for the purpose; and such local or detailed engineer shall report to said Chief of Engineers whether, in his opinion, said harbor or river is worthy of improvement, and shall state in such report fully and particularly the facts and reasons on which he bases such opinion, including the present and prospective demands of commerce. * * *

The channel known as the old "river-bed," it is claimed, was formerly a part of the Cuyahoga River. It became detached from the river, formed for a time a lake separate from the river, whilst the river obtained a new outlet about 1 mile east of the mouth of the old river-bed. Subsequently the city of Cleveland allowed a railroad embankment to be constructed across the old river-bed near its *debauché* into the lake.

In 1836 a connection was made between the Cuyahoga River and the old river-bed, but no connection was made with the lake. To-day the docks and slips built along this old channel are an important part of the dockage of Cleveland. It is now the wish of commercial and marine interests, as well as of property holders in the vicinity, to make an opening at the western end of the old river-bed through the railroad embankment into the outer harbor formed by the breakwater in the lake, and to widen, deepen, and improve the old river-bed. It is with a view to determining the cost of such an improvement that the desired survey is to be made.

The city of Cleveland had for some years expended funds in dredging both the main river channel and this old river-bed to deepen the same.

The old river-bed is the means of access to a large number of docks and slips from which large quantities of coal, iron ore, lumber, stone, &c., are received or shipped. Upon these docks are laid tracks which communicate with most of the railroad lines centering here, and in every respect this old river-bed is considered and treated as a part of the inner harbor of Cleveland, Ohio.

The harbor of refuge as at present constructed gives a secure protection to the shore where the desired opening would be made, and with such an exit the old river-bed would form an easy and valuable means of communication for vessels to pass from the harbor of refuge (outer harbor) to the inner harbor, or the reverse, whereas, now it is necessary to traverse a much longer route, and for a vessel consigned to a dock along the old river-bed the advantage would be still greater.

In its present unimproved condition, with one end closed, it is often necessary for the larger vessels which enter the old river-bed to be towed out stern foremost.

With the commerce of Cleveland growing as it has been each year, the necessity for the improvement of the old river-bed by some action on the part of private or public interests must increase annually, and the most natural and easiest way to improve it will be to widen and deepen it, and to connect it with the harbor of refuge at Cleveland, Ohio.

In view of the above, as local engineer in charge of the district, I am of the opinion that the opening and improving of the channel known as the old river-bed of the Cuyahoga River is worthy of improvement, and for the reasons herein stated.

The act of August 2, 1882, in providing for such surveys and reports as this, required the opinion of the local engineer in charge as to whether said harbor or river is worthy of improvement, and that the work is a public necessity.

The act of July 5, 1884, does not call for an expression of opinion on the part of the local engineer in charge of the district as to whether or not the work to be done is a public necessity; hence I am relieved from such responsibility as attaches thereto. In connection with this report I would respectfully refer to report of Maj. J. M. Wilson, Corps of Engineers (now Lieutenant-Colonel Wilson), dated October 13, 1882, upon survey of the channel known as the old river-bed, leading from the Cuyahoga River to the harbor of refuge, now under construction at Cleveland, Ohio.

In further compliance with the terms of circular from the Chief of Engineers, dated September 4, 1884, I have to respectfully submit estimate that will enable me to make survey and report contemplated by the act of July 5, 1884, to include the project and estimate of cost of improvement proper to be made.

FIELD WORK.	
Services of an assistant engineer fifteen days, say	$87 50
Services of six men fifteen days each, at $2 each per day	180 00
Services of one man, with use of boat, fifteen days, at $2.50 per day	37 50
	305 00
Contingent expenses (materials, &c.), 10 per cent	30 50
	335 50
OFFICE WORK.	
Services of two assistants, making maps, profiles, plans, estimates, &c., fifteen days each, say	152 50
Total	488 00

Very respectfully, your obedient servant,

L. COOPER OVERMAN,
Major of Engineers.

To the CHIEF OF ENGINEERS, U. S. A.

APPENDIX N N.

IMPROVEMENT OF THE HARBORS OF ERIE, PENNSYLVANIA, AND BUFFALO, NEW YORK, AND OF NIAGARA RIVER—IMPROVEMENT OF HARBORS ON LAKE ONTARIO.

REPORT OF CAPTAIN EDWARD MAGUIRE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Erie Harbor, Pennsylvania.
2. Buffalo Harbor, New York.
3. Niagara River, New York.
4. Wilson Harbor, New York.
5. Olcott Harbor, New York.
6. Oak Orchard Harbor, New York.
7. Charlotte Harbor, New York.
8. Pultneyville Harbor, New York.
9. Great Sodus Harbor, New York.
10. Little Sodus Harbor, New York.
11. Oswego Harbor, New York.
12. Sackett's Harbor, New York.

EXAMINATIONS AND SURVEYS.

13. Niagara River, New York, from Youngstown to Lake Ontario.
14. Scajaquada [Scajacuada] Creek, at Buffalo, N. Y.
15. Salmon River, New York, at and below Fort Covington.
16. Mouth of Salmon River, and the inner natural harbor thereat, on Lake Ontario, New York, with a view of making a harbor of refuge for vessels in distress and for purposes of commerce and navigation.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 16, 1885.

GENERAL: I have the honor to forward herewith my annual reports for the fiscal year ending June 30, 1885, for the works of river and harbor improvement under my charge.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

N N 1.

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA.

The only work done during the fiscal year was minor repairs to the north pier, and the south breakwater, amounting in all to $206.78.

In September and October, 1884, a survey was made of the peninsula.

(1) *Protection of the western neck of the peninsula.*—Most of the protection fences and pile jetties are in a dilapidated condition, but the narrowest parts of the peninsula are from 400 to 500 feet wide, with a crest rising about 5 feet above ordinary water.

The Board of Engineers of June 16, 1882, recommended that $24,000 be [illegible] Erie Harbor, to provide for [illegible] at the neck in case of necessity.

[illegible]—[illegible] in good condition.

The channel.—A chart of survey made on June 30, 1885, by Assistant [illegible] showed that the channel between the piers [illegible]. It also showed that there has been an increase [illegible] pier, and also to the south of it, due to the sand carried down from the head of the peninsula. The soundings of June 30, 1885, show a least depth of 13.4 feet at extreme low water, except off the end of the north pier, where the least depth is 12.2 feet.

The present project is to extend the piers to the 16-foot curve in the lake and to maintain a channel depth of not less than 16 feet through the bars inside and outside of the piers. Maj. M. B. Adams, Corps of Engineers, in his annual report for 1883, says:

> The amount required to complete the existing project, i. e., to extend both piers to 16 feet depth of water in the lake, cannot well be definitely stated, owing to the constant accumulation of sand on the outer bar, which makes it highly probable that extensions [illegible] feet to the north pier and 1,650 feet to the south pier, will be required to reach the 16-foot curve in the lake by the close of another season. * * * [illegible] * * * the sand should be prevented from accumulating as it now does, either large amounts of sand will require removal or else indefinite extensions of the piers must be made in order to maintain a depth of 16 feet through the outer bar. There are required at present [illegible] feet of pier extension, 700 feet to the north pier and [illegible] feet to the south pier, in order to reach the place where the 16-foot curve [illegible], which, at a cost of $57 per foot, will amount to $133,[illegible], the sum required to complete the existing project at the present time.

I have nothing to add to the above, except in the way of indorsement of the statements made, but, in my opinion, there should be no further extension of the north pier. During storms the water rushes through the channel between the piers like a mill race, and again upon the cessation of the storm, when the lake begins to resume its level. The longer the channel is made, under these circumstances, the more difficult it will become for vessels to enter the harbor. In my opinion, the movement of the sand from and along the peninsula may be *arrested* in the manner proposed in my report of January 7, 1885. In view of the fact that the channel has already shoaled in front of the piers, I am of opinion that the south pier may profitably be extended 400 feet. The estimate for the breakwater protection of the neck and the jetties, as submitted in the report above referred to, is 147,044.50.

The estimate for 400 feet extension of the south pier is $26,000, or a total of $173,044.50, and the amount which is asked for is $126,000.

In the money statement the amount given for the completion of the existing project is that estimated for the prolongation only of both piers.

Money statement.

July 1, 1884, amount available		$12,037 06
Amount appropriated by act approved July 5, 1884		50,000 00
		62,037 06
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,726 20	
July 1, 1885, outstanding liabilities	180 00	
		2,906 20
July 1, 1885, amount available		59,130 86
Amount (estimated) required for completion of existing project		$84,120 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		126,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Name of harbor, Erie, Pa.
Collection district, Erie, Pa.
Nearest light, Erie, Pa., a coast light of the fourth order, flashing red and white, on the north shore of the peninsula; a fixed red light of the sixth order on the outer end of the north pier; two fixed white lights of the sixth order marking the range of the channel within the bay. There is a fog-bell on the outer end of the north pier.
Nearest work of defense, Fort Porter, New York.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departure.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers and sailing vessels	640	540, 489	643	543, 018

Amount of revenue collected during the year ending December 31, 1884	$2, 540 26
Value of imports same year	24, 337 35
Value of exports same year	2, 929 50

N N 2.

IMPROVEMENT OF BUFFALO HARBOR, NEW YORK.

The first appropriation for the improvement of this harbor was made in 1826. The project, as modified at various times, provided for the construction of a north and of a south pier at the mouth of Buffalo Creek, a masonry sea-wall running south from the south pier, and a breakwater a little less than one-half mile distant from, and in front of, the Buffalo light-house, its long arm running nearly parallel with the general shore-line, in a direction nearly northwest and southeast.

The sea-wall was finished long ago, as were also the north and south piers. Since the adoption of the breakwater the sea-wall ceased to form a part of the project for the improvement of this harbor.

THE NORTH PIER.

Under agreement of December 9, 1879, with the War Department, the larger portion of the north pier was used by the Delaware, Lackawanna and Western Railroad Company as a coal wharf. The Report of the Chief of Engineers for 1880, Part III, page 2195 *et seq.*, contains a full account of the first aggressive action of the above mentioned corporation to gain possession of the United States north pier. It will be seen that it at the time (1879) became necessary to place troops on the pier to compel the corporation to respect the rights of the Government and to submit the matter in controversy to the Secretary of War. The matter was peaceably adjusted in 1879, and the railroad company executed the stipulation, a copy of which is to be found in the report above referred to. On page 2197 of the same report will be found a letter from Sherman S. Rogers, counsel for the company, in which it is stated: "First. The railroad company claims, and believes it will at the proper time be able to satisfy the Government authorities, that it is the owner in fee by regular, proper title of the land on which the pier rests." Nearly six years have elapsed since the date of that letter, and the railroad company has not been able to satisfy the Government authorities that it has a proper title to the land on which the pier rests. In fact, no attempt was made to show such title until in January last, when I protested against any work being done by the company on the north pier without the consent of the Secretary of War. Then one of the attorneys of the company, Franklin D. Locke, of Buffalo, did attempt to prove to me that the company had a title to the land, but failed so to do.

This question of title was discussed by me in two reports sent to the Chief of Engineers and printed in House Ex. Doc. No. 259, Forty-eighth Congress, second session.

On October 23, 1884, I found it necessary to send the following letter:

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., October 23, 1884.

SIR: I have been informed that under your direction certain work has been commenced on the outer end of the United States north pier. I know of no authority possessed by the Delaware, Lackawanna and Western Railroad Company to do any work at that point. You will therefore please cause the work to be stopped immediately, and inform this office of the nature and extent of the work which you desire to do. Should it be approved by me, I will forward it to the Secretary of War for his approval. But until such approval be received by you I must insist, and shall insist, that you cease operations on the outer end of the pier.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

Mr. J. J. MCWILLIAMS,
Agent Delaware, Lackawanna and Western Railroad Company, Buffalo, N. Y.

In reply I received the following letter:

AGENCY DELAWARE, LACKAWANNA AND WESTERN RAILROAD COMPANY,
COAL DEPARTMENT,
Buffalo, N. Y., October 23, 1884.

DEAR SIR: Your favor of this date is duly received. The nature and extent of the work that we had intended to do on the outer end of the old north pier was entirely preservative in its character, as the fire the other evening had left the pier in condition to rapidly disintegrate, and we were only putting it in shape to stand the seas and storms that we always get at this time of year, and thus prevent it falling to pieces and becoming an obstruction to navigation. This should be done right away, and to get it done at once we started to go ahead with it.

Very truly,

J. J. MCWILLIAMS.
Agent.

Capt. EDWD. MAGUIRE,
Captain of Engineers, U. S. A.

That letter I forwarded to the Chief of Engineers, with the following indorsement:

Respectfully forwarded to the Chief of Engineers, U. S. A.

The within letter was sent to me in response to a letter from me informing Mr. McWilliams that the Delaware, Lackawanna, and Western Railroad Company must have authority from the Secretary of War before doing any work on the outer end of the United States north pier.

The outer end of the United States north pier is beyond the wharf-line as established by the city of Buffalo. But the railroad company now occupies the north pier simply on sufferance under the stipulation of December 9, 1879. As I am in doubt as to how the rights of the United States may be affected by any further work on the pier, I preferred to put a stop to all operations by the railroad company until I could secure instructions in the matter. The work which the company proposes to do will not prove injurious to commerce or navigation. Should the work be authorized, I would request to be informed whether a new stipulation with the company should be m

EDWD. MAGUIRE,
Captain of Engineers.

In response to the above indorsement I received the following letter:

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., November 7, 1884.

SIR: The letter of Mr. John J. McWilliams, western sales agent Delaware, Lackawanna and Western Railroad Company, of October 23, 1884, stating the nature and extent of work which the railroad company proposed to do at the outer end of United States north pier at Buffalo Harbor, New York, forwarded to this office with your indorsement of the 24th ultimo, was duly received.

The following copies of the second and third indorsements thereon, showing the action of this office and of the War Department, are furnished for your information and guidance:

"OFFICE CHIEF OF ENGINEERS,
"UNITED STATES ARMY,
"*October* 31, 1884.

"Respectfully submitted to the Secretary of War.

"The United States north pier at Buffalo Harbor, New York, is occupied by the Delaware, Lackawanna and Western Railroad Company, with the consent of the United States, pending certain questions in reference to title, and under stipulations imposed by the United States and accepted by the company.

"The work proposed to be done by the company will not prove injurious to navigation or commerce, and is intended to repair certain damages caused the pier by a recent fire. There appears to be no objection to permitting this work to be done, provided it be distinctly understood that the existing agreement between the United States and the railroad company be in no way interfered with, and that no claim or attempted claim to title upon the part of the company be based upon the permission thus granted. No additional stipulation would seem to be required other than the acceptance by the company of the privilege granted upon the condition named, it being at the same time understood that the United States is not to be in any way liable for expense arising from the prosecution of the work in question. In this connection attention is invited to the accompanying copy of Appendix J J, of the Report of the Chief of Engineers for 1880, which contains on pages 2192 to 2204, a full statement of the facts connected with the occupation of the pier by the railroad company.

"JOHN G. PARKE,
"*Acting Chief of Engineers.*"

"Authority is granted for the work in question under the stipulations, restrictions, and conditions suggested in the foregoing indorsement of the Acting Chief of Engineers.

"By order of the Acting Secretary of War.

"JAY STONE,
"*Acting Chief Clerk.*

"WAR DEPARTMENT, *November* 4, 1884."

Very respectfully, your obedient servant,

JOHN G. PARKE,
Acting Chief of Engineers.

Capt. EDWARD MAGUIRE,
Corps of Engineers.

Copies of the above communication were inclosed in the following letters sent by me:

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., November 10, 1884.

SIR: I have the honor to send the inclosed paper for your information. A copy of the same paper will be sent to Mr. McWilliams.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers, in charge.

F. D. LOCKE, Esq.,
Attorney Delaware, Lackawanna and Western Railroad Company, Buffalo, N. Y.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., November 10, 1884.

SIR: I have the honor to send you herewith a copy of a letter received by me this morning.

In acknowledging its receipt please inform me whether you will do the work proposed.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

Mr. JOHN J. MCWILLIAMS,
Western Sales Agent,
Delaware, Lackawana and Western Railroad Company, Buffalo, N. Y.

I received the following letter:

AGENCY OF THE DELAWARE, LACKAWANNA AND
WESTERN RAILROAD COMPANY, COAL DEPARTMENT,
Buffalo, N. Y., November 11, 1884.

DEAR SIR: Yours of 10th, with copy of a letter from the Chief of Engineers, U. S. Army, dated Washington, November 7, I have, and in accordance therewith, I will go ahead and prosecute the work as stated in mine of October 23, to you.

Very truly,

J. J. MCWILLIAMS,
Western Sales Agent.

Capt. EDWD. MAGUIRE,
Captain of Engineers, U. S. A.

It will thus be seen that the railroad company was perfectly aware that the authority of the Secretary of War was necessary to enable it to do any work on the pier. In January, 1885, the company again commenced unauthorized work, and I sent the following letter:

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., January 3, 1885.

SIR: I understand that you propose to extend the trestles on the United States north pier. If so, please inform me at your earliest convenience of your plans in detail, and furnish me with a map showing the proposed location and limits of the extension, so that I may determine whether or not the work can be permitted.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

Mr. JOHN J. MCWILLIAMS,
Western Sales Agent, Delaware, Lackawanna
and Western Railroad Company, Buffalo, N. Y.

In reply I received the following:

AGENCY OF THE DELAWARE, LACKAWANNA AND
WESTERN RAILROAD COMPANY, COAL DEPARTMENT,
Buffalo, N. Y., January 5, 1885.

DEAR SIR: I have to acknowledge receipt of your favor of the 3d instant and in answer would say, that we have no intention of extending our trestle on the north pier. That the work we are doing there is only repairing damages by fire and water. That the work is about finished, except to put caps on the piles to hold them in their place, that they may hold the stone-work in its place.

The timber that you see being delivered on our yard is for changing our plans and altering the other end of the trestle, *i. e.*, towards the Bennett elevator. The work we are doing on the north pier is, I think, entirely in accordance with the inclosure from you November 10, 1884.

Very truly,

J. J. MCWILLIAMS,
Western Sales Agent.

Capt. EDWD. MAGUIRE,
Captain of Engineers, U. S. A.

To that I replied as follows:

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., January 5, 1885.

DEAR SIR: I have to acknowledge yours of this date. It is the alteration which you propose to make on the end of the trestle towards the Bennett elevator, which, from what I have heard, will cut off the Government's right of way to the landing stage at the inner end of the United States north pier. If you propose to extend the trestle back along the United States north pier, of course the authority of the Secretary of War must be obtained, and I, of course, should object to having the right of way to the landing stage cut off, for it is the only way we have of communicating directly with the reservation on the south side of Buffalo Creek. I will call at your office to-morrow afternoon at 3 o'clock, to see what you propose to do.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

Mr. J. J. MCWILLIAMS,
Western Sales Agent, Delaware, Lackawanna
and Western Railroad Company, Buffalo, N.Y.

The following letter was also sent:

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., January 10, 1885.

SIR: My assistant engineer, Mr. Kingsley, informs me that you, this morning, explained to him your plans in regard to your trestles. I prefer that you explain these plans to me, who am the officer in charge. If you will appoint an hour and date when convenient for you I will be in my office to look at the plans you may bring. But please understand that I shall oppose any further construction on the north pier unless you first obtain the authority of the Secretary of War.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers, in charge, Buffalo Harbor.

Mr. J. J. MCWILLIAMS,
Western Sales Agent, Delaware, Lackawanna
and Western Railroad Company, Buffalo, N. Y.

I had several interviews with Franklin D. Locke, the attorney of the company, in each of which I informed him that the company must obtain the permission of the Secretary of War to do any work on the pier. Notwithstanding this the company attempted to resume work, and I found it necessary to send the following:

UNITED STATES ENGINEER OFFICE,
Buffalo. N. Y., January 22, 1885.

SIR: I understand that by your direction certain work is being done on the United States north pier at the landing stage. You will please desist from *all work of any kind* until authorized by the Secretary of War. You understand, or should understand by this time, that neither you nor any one else connected with the Delaware, Lackawanna and Western Railroad Company has any right to do any work whatever on the United States pier without authority. I trust that I shall not be obliged to call your attention to this matter again. The matter stands just at this point. You must not make any changes until you receive notice through Messrs. Rogers, Locke, and Milburn, the attorneys of the company, with whom I shall hereafter transact all business relating to the pier.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

Mr. J. J. MCWILLIAMS,
Western Sales Agent, Delaware, Lackawanna
and Western Railroad Company, Buffalo, N. Y.

I also went in person to the office of the attorney to protest against any work being done. The reply made to my protests was, that there was a difference of opinion as to the rights of the company. On January 23, finding that the company had a large force of men at work on the pier, I again in person protested to the attorney, and being unable to secure any promise or guarantee that the work would be stopped, I sent the following telegram:

BUFFALO, N. Y., *January* 23, 1885.

The Delaware, Lackawanna and Western Railroad Company has twenty-eight men at work on United States north pier, in spite of my repeated protests. Both agent and attorneys refuse to wait for decision of Secretary of War. If allowed to go on they will close up our right of way to the landing stage. I request authority to call on commanding officer of Fort Porter for a force to compel the company to stop work until the Secretary of War can decide the matter.

MAGUIRE,
Engineers.

CHIEF OF ENGINEERS, U. S. A.

In reply I received the following telegram:

Commandant officer, Fort Porter, has been instructed by telegraph to immediately send a sufficient guard to prevent encroachments upon the rights of the United States referred to in your telegram to the Chief of Engineers.

ROBERT T. LINCOLN,
Secretary of War.

Capt. EDWD. MAGUIRE,
Corps of Engineers.

At 8 o'clock the next morning (January 24) a guard, under command of Capt. O. W. Pollock, Twenty-third Infantry, was placed on the pier and the foreman peaceably withdrew with his men. About two hours afterward one of the attorneys of the company, John George Milburn, accompanied by J. J. McWilliams, came to the pier. I informed the attorney that no work could be done until authorized by the Secretary of War. He gave me his word that no further work would be attempted until I received notice. The guard was then withdrawn.

On January 26 I received the following letters:

AGENCY OF THE DELAWARE, LACKAWANNA AND WESTERN
RAILROAD COMPANY, COAL DEPARTMENT.
Buffalo, N. Y., January 26, 1885.

DEAR SIR: In accordance with an understanding had by our counsel, Mr. John G. Milburn, with you on January 24, we intend to resume repairs upon our dock at once (to-morrow morning), said work to be done in accordance with stipulation between this company and the War Department made December 10, 1879.

Repairs will be made as per plans in this office, and which have been fully explained to you, but which, judging from an expression made by you on our dock on Saturday, you do not credit as being entirely true.

Very respectfully,

JOHN J. MCWILLIAMS,
Agent Delaware, Lackawanna and Western Railroad Company.

Capt. EDWD. MAGUIRE,
Captain of Engineers, U. S. A.

OFFICE OF ROGERS, LOCKE & MILBURN,
COUNSELORS AT LAW,
Buffalo, N. Y., January 26, 1885.

MY DEAR SIR: I returned from New York late Saturday evening, and only learned yesterday that war had been declared and the troops ordered out. I very much regret the condition of matters. Mr. Milburn states that he is under engagement to you not to prosecute the work without notice to you, but Mr. McWilliams desires to proceed, and I suggest, therefore, that you regard Mr. Milburn's engagement fulfilled by this note.

Yours, very respectfully,

FRANKLIN D. LOCKE.

Capt. EDW. MAGUIRE.

Copies of the above letters were sent to the Chief of Engineers, with the following:

GENERAL: Yesterday I reported that the Delaware, Lackawanna and Western Railroad Company had ceased work on the United States north pier on the 24th instant, and that I having received the word of Mr. Milburn, one of the attorneys of the company, that no work would be attempted, the guard was withdrawn.

To my surprise I yesterday received the two letters forwarded herewith. In an interview with the attorneys Mr. Milburn acknowledged that he had distinctly understood me to say that the work could not go on without the authority of the Secretary of War, but that in promising me that the work should be stopped, he intended that it should cease until he gave me notice that it would be resumed. Such was not my understanding or I certainly should not have consented that the guard be withdrawn; but I refrain from any criticism as to the attorney's course. As to Mr. McWilliams' statement that he would resume work in accordance with an understanding had with me by Mr. Milburn, I have already replied to that above.

Mr. McWilliams states that the work of *repairs* will be resumed, wherein he is again disingenuous, for the work he proposes to do is almost entirely new in its character. Mr. Locke informs me that, unless I hear from him in the mean time, the company will attempt to resume work on Friday morning, the 30th instant. Should such an attempt be made, the commanding officer of Fort Porter will place a guard on the pier, which will remain until the matter is definitely settled.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

CHIEF OF ENGINEERS, U. S. A.

On January 29 the following telegram was sent:

Attorney of Delaware, Lackawanna and Western writes me that the question of north pier will be presented to Secretary of War on Monday or Tuesday next, and until so presented no work will be attempted by company on disputed territory. He will not consent to promise to stop work until Secretary of War decides the matter, but only until it is presented to him. I request instructions whether I shall have guard on pier if company resume work before I receive decision of Secretary of War. Please answer this afternoon.

MAGUIRE,
Engineers.

CHIEF OF ENGINEERS, U. S. A.

In reply I received the following telegram:

Continue the guard without interruption and prevent encroachments until further instruction from this Department. Report proceedings under this and former orders.

ROBERT T. LINCOLN,
Secretary of War.

Captain MAGUIRE,
Corps of Engineers.

The following morning the guard was again placed on the pier and kept there until February 6, when it was withdrawn in consequence of the receipt of the following telegram:

WASHINGTON, D. C., *February* 5, 1885.

The Secretary of War directs me to inform you that Lieutenant-Colonel McFarland will be sent to Buffalo, as being specially familiar with previous history of difficulty, to make report; probably get there Tuesday. Mr. Holden, railroad agent here, agrees company will not proceed with work claimed by you to be encroachments until matter settled here, and that no guard is needed in the mean time. No reason to doubt good faith, and, unless you think otherwise, it would seem the military guard need not stay on the wharf. It will be just as well, however, to keep a lookout.

PARKE,
Engineers.

Captain MAGUIRE, *Engineers.*

On February 10, Lieut. Col. Walter McFarland, Corps of Engineers, took charge of the matter, and it was finally adjusted, the railroad company executing a new stipulation:

SUPPLEMENT MADE THIS 14TH DAY OF FEBRUARY, 1885, TO A STIPULATION BETWEEN THE UNITED STATES OF AMERICA AND THE DELAWARE, LACKAWANNA AND WESTERN RAILROAD COMPANY, DATED THE 9TH DAY OF DECEMBER, 1879.

The Delaware, Lackawanna and Western Railroad Company (hereinafter called "The Company") is proposing to build five additional coal-pockets on the southeasterly portion of the premises known as the north pier and on the adjacent premises, and to alter the trestles thereon so far as is necessary for that purpose.

The United States opposes the construction of such coal-pockets and the alteration of the trestles. This controversy is now settled and arranged as follows:

The United States withdraws its opposition to the construction of such additional coal-pockets and such alterations of the trestles upon the Company agreeing to comply with the following conditions:

(1) The Company will submit to the United States plans of the proposed additions and alterations, and will construct them in accordance with such plans as approved by the War Department.

(2) For the accommodation and convenience of the officers and men engaged in the service of the United States, it will build upon the property of the United States, on the south side of Buffalo Creek, at such a location as may be designated by the United States engineer in charge, a boat-house and boat-landing similar to those now existing, and which were furnished by the Company under the stipulation of December 9, 1879. The new boat-house and boat-landing shall not differ materially in its dimensions, nature, and cost from the existing boat-house and boat-landing built under the stipulation of December 9, 1879, as aforesaid. Upon the completion of the new boat-house and boat-landing the Company shall have the right to remove the said existing boat-house and boat-landing, and their further use shall then be discontinued and abandoned.

The intention is that the new boat-house and boat-landing is to be accepted by the United States as a substitute for the existing boat-house and boat landing built for the United States by the Delaware, Lackawanna and Western Railroad Company.

(3) The Company is to provide and maintain on the Buffalo Creek, at the northeasterly end of the premises originally known as the north pier, a landing stairs leading from the surface of the dock to the water, of not less than 5 feet in width, and to ascend from the water at an easy and proper angle to the surface of the dock, and to [illegible] in accordance with the plan to be submitted as hereinbefore provided.

(4) The Company is to permit the officers and men in the service of the United States, and other persons having business with them, to have access to such landing-stairs over its tracks and property lying in the rear thereof, and it is to keep open for that purpose a passage-way across the same 5 feet in width.

(5) The Company is to keep the water front at such landing-stairs free from obstruction by vessels loading or unloading at its docks, so far as may be practicable and consistent with the necessary and usual requirements of the maritime uses of that portion of the Buffalo Harbor and River, and it is to promote the convenience of the officers and men in the service of the United States in the use of such landing-stairs and in the access to the same so far as is practicable, having in view the reasonable requirements of the business of the Company carried on upon the adjacent property and the uses to which it is put.

(6) The Company before engaging in any further new construction on the premises known as the north pier will give two months' notice of its intention to do so to the War Department, accompanying its notice with the plan of the proposed new work; but this provision is not to be construed as a concession by either the United States or the company of any rights or interests in the premises on the part of the other.

(7) This stipulation and the agreements and conditions it contains are not to affect in any manner whatever the rights or interests of the United States, or the company, in the premises known as the north pier, and are not to be taken as a concession by either party that the other party has any such rights or interests, or as a waiver of any such rights or interests.

(8) This supplementary stipulation to go into effect when signed by the president of the Delaware, Lackawanna and Western Railroad Company, sealed with the corporate seal of said company and approved by the Secretary of War.

In witness whereof the said Delaware, Lackawanna and Western Railroad Company hath caused these presents to be signed by its president, and its corporate seal to be hereunto attached. Attested by its secretary this the 14th day of February, A. D. 1885, by authority of the board of managers of said company.

THE DELAWARE, LACKAWANNA AND WESTERN RAILROAD COMPANY,
[SEAL.] By SAM. SLOAN, *President.*

Attest:
FRED. F. CHAMBERS,
Secretary.

Approved by the Secretary of War, and by his direction the seal of the War Department is hereunto attached, this 19th day of February, A. D. 1885.

[SEAL.] ROBERT T. LINCOLN,
Secretary of War.

THE BREAKWATER.

(1) *Construction.*—Work was continued on the extension of the breakwater under the contract of Charles E. Williams, dated February 21, 1884, and was closed October 29. Under this contract the breakwater was extended southwardly 805.9 feet, and has now a completed length of 5,696.9 feet. The following materials were used:

Hemlock timber and plank	feet, B. M.	1,476,432
Pine timber and plank	do	640,420
Oak timber and plank	do	78,777
Stone filling	cords	5,593.5
Stone foundation	do	855.36
Stone riprap	do	54.79

The iron was furnished by A. J. Packard, under contract dated December 13, 1882. The following amounts were used for the work:

Drift-bolts	pounds	260,893
Screw-bolts and washers	do	23,142
Spike	do	14,600

The total cost of the extension was $89,783.58, or (not including superintendence) $111.40 per linear foot. On September 13, 1884, bids were received for an extension of the breakwater.

The following is an abstract of the bids:

Abstract of proposals for the extension of the Buffalo breakwater, received and opened at United States engineer office, Buffalo, N. Y., at 11 o'clock a. m. (75th meridian time), September 13, 1884, under advertisement of August 14, 1884.

(Approximate quantities.)

No.	Names and addresses of bidders.	Hemlock, 720,000 feet, B. M.	White pine, 360,000 feet, B. M.	White oak, 42,000 feet, B. M.	Screw-bolts, 6,000 pounds.	Drift-bolts, 130,000 pounds.
1	Charles E. Williams, Buffalo, N. Y				$0 03 1/10	$0 02 3/10
2	Pratt & Co., Buffalo, N. Y				03¼	1 9/10
3	Andrew J. Packard, Buffalo, N. Y				*3 02½	*1 97
4	Charles E. Williams, Buffalo, N. Y	$17 65	$26 00	$33 00		
5	Ira Farnsworth, Lockport, N. Y	16 00	28 00	35 00		
6	Daniel E. Bailey, Buffalo, N. Y	17 00	27 00	35 00		
7	William H. Upson, Lockport, N. Y	18 50	28 00	34 00		
8	Aaron H. Chapman, Robert H. Canfield, Henry A. Canfield, Watkins, N. Y	18 00	28 00	35 00		
9	Charles A. Gatchell, Buffalo, N. Y	18 50	27 50	34 00		
	Thomas Collins, Buffalo, N. Y				04½	04
10	Lewis P. and James A. Smith, Cleveland, Ohio	18 00	28 00	33 00		
11	William McRea, Lockport, N. Y	17 50	30 00	35 00		
	Charles Whitmore, Lockport, N. Y				07	06
12	Samuel Gibson, Buffalo, N. Y	19 00	23 00	39 00		
					03	02½
13	George Talbot, Buffalo, N. Y	17 00	25 00	35 00		

No.	Names and addresses of bidders.	Wrought spike, 5,000 pounds.	Stone filling and foundation, 3,400 cords.	Stone riprap, 120 cords.	Total.
1	Charles E. Williams, Buffalo, N. Y	$0 02⅗			$3,306
2	Pratt & Co., Buffalo, N. Y	02⅖			2,785
3	Andrew J. Packard, Buffalo, N. Y	*2 55			2,870
4	Charles E. Williams, Buffalo, N. Y		$4 50	$8 00	39,714
5	Ira Farnsworth Lockport, N. Y		4 40	9 00	39,110
6	Daniel E Bailey, Buffalo, N. Y		5 00	10 00	41,630
7	William H. Upson, Lockport, N. Y		4 85	10 00	42,518
8	Aaron H. Chapman, Robert H. Canfield, Henry A. Canfield, Watkins. N. Y		5 00	12 00	42,950
9	Charles A. Gatchell, Buffalo, N. Y		4 90	8 95	42,382
	Thomas Collins, Buffalo, N. Y	03½			5,645
10	Lewis P. and James A. Smith, Cleveland, Ohio		5 50	8 50	44,146
11	William McRea, Lockport, N. Y		5 50	12 00	45,010
	Charles Whitmore, Lockport, N. Y.	05			8,470
12	Samuel Gibson, Buffalo, N. Y		5 00	8 50	41,618
		02½			3,555
13	George Talbot, Buffalo, N. Y		4 90	10 00	40,570

* Per 100 pounds.

The contract for work and material, other than iron, was awarded to Ira Farnsworth, of Lockport, N. Y.; Pratt & Co., of Buffalo, received the contract for iron. The latter contract was closed November 20, 1884, all of the iron having been accepted.

Under Farnsworth's contract the foundation of broken stone was completed during November, 1884, for a total distance of 200 feet.

It not being deemed advisable to carry the foundation further at that time, work ceased until January, 1885. Since that time the work has been energetically prosecuted by the contractor. Up to the close of the fiscal year the amount of work accomplished was as follows:

Nine cribs had been built and sunk, four being of twenty-one courses and five of nineteen courses, or a total length of substructure and foundation of 450 feet, leaving 200 feet yet to be completed under the contract. The superstructure was partially built over the first 200 feet. At the rate at which work is being carried on the contract will be completed early in the coming fiscal year.

(2) *Repairs of the breakwater* under contract with D. E. Bailey, dated May 26, 1884. Under this contract the repairs consisted in tearing down the old work to water-line on the inner side, and to 4 feet above water-line on the outer side, rebuilding the whole to 5 feet above water-line on the inner 22 feet, and 12 feet above water-line on the outer 12 feet; also repairing the protection crib and putting new deck plank and wall timbers in such other portions as required it.

The following materials were used:

Pine timber and plank	feet, B. M.	452,435
Oak timber and plank	do	36,510
Old work removed	do	324,191
Stone filling	cords	482.7
Spike	pounds	6,600
Drift-bolts	do	77,676
Screw-bolts and washers	do	144

The total cost was $17,396.42.

(3) *Repairs of the breakwater* under contract with D. E. Bailey, dated September 6, 1884. Proposals were opened August 23, in response to a circular letter of August 18, for repairing the top of cribs 43 to 49 on the inside of the breakwater. The following is an abstract of the bids:

Abstract of proposals for the repair of the Buffalo Breakwater, received and opened at the United States engineer office, Buffalo, N. Y., at 11 o'clock a. m. (75th meridian time), August 23, 1884, in response to circular letter of August 18, 1884.

[Approximate quantities.]

No.	Names and addresses of bidders.	White pine, 127,000 feet, B. M.	White; oak, 10,000 feet, B. M.	Stone filling, 60 cords.	Riprap stone, 40 cords.	Piles, 10,000 linear feet.	Spike, 400 pounds.	Removing old work, &c.	Totals.
1	David W. McConnell, Buffalo, N. Y.	$36	$45	$4 94	$9	$0 34	$0 3½	$950	$10,042 40
2	D. E. Bailey, Buffalo, N. Y.	29	40	5 00	16	35	3	200	8,735 00

The contract was awarded to D. E. Bailey. The work, which was completed early in December, consisted in building and sinking 300 linear feet of crib-work upon the tops of the repair cribs and breakwater cribs 48 and 49, which settled out of line in 1873, and in building upon the top of the crib-work 5 feet of superstructure, filled with stone and decked over. In order to prevent the stone filling from washing out, a row of close piling was driven on the inner side, bonded into the superstructure and protected by two 8 by 12 inch oak waling-pieces running the entire length.

The following materials were used in the work:

Pine timber and plank	feet, B. M.	173,051
Oak timber and plank	do	31,112
Stone filling	cords	239
Stone riprap	do	43.25
Piles	linear feet	9,701
Spike	pounds	1,500
Drift-bolts	do	6,203
Screw bolts and washers	do	3,994

The total cost, including the removing of old work, was $12,123.45.

(4) *Repairs of the south and pile piers.*—Under contract with D. E. Bailey, dated October 11, 1884. On September 23 bids were opened for the repair of the south and pile piers. The following is an abstract of the bids:

Abstract of proposals for repairing the south and pile piers at Buffalo Harbor, New York, received and opened at United States engineer office, Buffalo, N. Y., at 11 *o'clock a. m.* (75*th meridian*), *September* 23, 1884, *under advertisement of August* 23, 1884.

[Approximate quantities.]

Materials.	Robert W. McIntire, Buffalo, N. Y.	David W. McConnell, Buffalo, N. Y.	Daniel E. Bailey, Buffalo, N. Y.	Louis Harbrecht, Buffalo, N. Y.
Pile pier:				
White pine, 21,000 feet, B. M	$35 00	$27 00	$29 00	$27 00
White oak, 12,000 feet, B. M	60 00	38 00	40 00	48 00
Stone filling, 87 cords	6 50	5 50	5 00	8 50
Spike, 1,700 pounds	3½	2.6	3	4
Washers, 525 pounds	4	3	3	3½
South pier:				
Removing old work, 40,000 feet, B. M	10 00	5 00	6 00	3 75
Removing 10 old piles, each	10 00	2 00	5 00	2 00
White-oak piles, 960 linear feet	40	28	30	30
White-oak timber, 106,000 feet, B. M.	40 00	39 00	36 00	40 00
Bolts, screws, and washers, 1,500 pounds	5	3½	3	5
Bar iron and washers, 1,500 pounds	4	2¼	3	4
Drift-bolts, 8,000 pounds	4	2¼	3	4
Spike, 5,700 pounds	3½	2.6	3	3
Totals	8,554 50	7,098 70	6,890 75	7,967 87½

The work on the pile-pier, which was completed in November, 1884, consisted in renewing old deck planks, joists, and stringers, and stone filling. The materials used were as follows:

Oak timber	feet, B. M.	6,956
Pine plank	do	25,682
Stone filling	cords	62.2
Washers	pounds	790
Spike	do	1,600

The total cost was $1,406.73.

The work on the south pier was completed January 29, 1885. It consisted in renewing the pile protection along the channel-face of the pier. Old piles were pulled out and replaced by new ones, and the upper 3 feet of the piles were tied together by three courses of 8 by 12 inch oak stringers, held in place by screw and drift bolts; on the harbor-face an oak fender was placed to prevent chafing by vessels. The following materials were used:

New piles	linear feet..	4,[illegible]
Oak timber and plank	feet, B. M..	[illegible]
Screw-bolts and washers	pounds..	[illegible]
Bar-iron	do....	1,[illegible]
Spike	do....	6,[illegible]
Drift-bolts	do....	[illegible]

The total cost, including the removal of 163 old piles and 37,866 feet B. M., of old work, was $7,048.94.

(5) *Miscellaneous repairs.*—The damage to the breakwater, caused by a vessel in October, 1884, was, under authority of the Chief of Engineers, repaired by D. E. Bailey at a cost of $50.

On November 14, another vessel ran head on to the breakwater. This damage was repaired under the authority of the Chief of Engineers, by D. E. Bailey, at a cost of $40. The damage caused to the breakwater by vessels has increased so much in the past few years that it would seem proper that some legislation should be enacted under which the owners of vessels, carelessly or inefficiently handled, may become liable for the injury done by these vessels to Government works. On June 28 advertisements were published calling for proposals for repairs to the breakwater, caused by severe storms during the winter of 1884–'85. The proposals will be opened on July 30. The work contemplated under that contract, together with that under Farnsworth's contract of October 4, 1884, with such repairs as may become necessary, will constitute the operations for the new fiscal year.

As stated in my last annual report the superstructure of about 2,000 feet of the breakwater should be rebuilt at a cost of $66,000.

The total length of the breakwater as projected by the Board of Engineers of August 6, 1874, but subsequently modified, owing to a correction in the position of the shore end of the shore arm was:

	Feet.
Main or detached break-water of cribwork	7,600
Shore arm of crib-work	3,250
Pile pier of shore arm	1,000
Total length	11,850

Of which there has been built—

	Feet
Main breakwater completed to June 30, 1885	5,696.9
Main breakwater under contract	650
Pile pier completed to June 30, 1885	870
Total	7,216.9
Still to be built	4,633.1

The estimated cost of the breakwater (Annual Report of the Chief of Engineers, 1875, Part I, page 321) was $250 per running foot for the main portion, and $150 per foot for the shore arm. Since 1878 the cost of the main breakwater has been as follows:

Clark's contract, 1879	$160 00
Colton's contract, 1880	184 00
Bailey's contract, 1880	206 00
Bailey's contract, 1880–'81	206 00
Hingston & Wood's contract, 1881–'82	160 00
Williams's contract, 1883–'84	117 92
Farnsworth's contract (estimated), 1884–'85	100 00

In 1880 and 1881 the depth of mud excavated for the foundation was greater than under any other contract. Under the existing and future contracts no excavation will be necessary, the natural bottom of the lake being hard enough to sustain the work. The above rates include all expenses of every kind, the net cost of workmanship being 6 to 8 per cent. less than these rates according to the amount of work done.

There is an increasing demand for wharf room at Buffalo, making an early completion of the breakwater a necessity. When constructed, the breakwater will cover about 8,000 feet of available wharf room. As there is no dredging now to delay the work, there is practically no limit to the amount of work which can be done in one season.

Buffalo Harbor, New York, is situated within the collection district of Buffalo Creek, New York. It is lighted by a third-order fixed white light at the outer end of the south pier; a fixed red fourth-order light at the north end of the breakwater, with a fog bell attached to the keeper's dwelling, and a fixed white light of the fourth order, varied with white flashes on Horseshoe Reef, at the entrance to Niagara River. Fort Porter is within the city limits on the Niagara River. The total amount appropriated for this harbor up to the close of the fiscal year, was $1,761,880.41, of which $1,621,117.92 have been expended. The amount expended on the present project, from its adoption in 1874 to June 30, 1885, is $707,490.45.

Money statement.

July 1, 1884, amount available		$84,013 58
Amount appropriated by act approved July 5, 1884		100,000 00
		184,013 58
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$111,363 93	
July 1, 1885, outstanding liabilities	13,195 71	
		124,559 64
July 1, 1885, amount available		59,453 94
Amount (estimated) required for completion of existing project		1,230,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		500,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Arrivals and departures of vessels during the year ending December 31, 1881.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	1,676	1,553,390	1,643	1,497,057
Sailing vessels	1,994	671,979	1,989	688,912
Total	3,670	2,225,369	3,632	2,185,969

Amount of revenue collected during the year ending December 31, 1884	$906,395 95
Value of imports same year	5,082,705 00
Value of exports same year	375,299 00

Greatest draught of vessels, 15 feet 6 inches.

N N 3.

IMPROVEMENT OF NIAGARA RIVER, NEW YORK.

No work was done during the fiscal year; all that was contemplated having been finished.

Available funds will be held for such application as may be necessary for the further improvement of the channel.

No appropriation is at present asked for.

Money statement.

July 1, 1884, amount available	$1,500 00
July 1, 1885, amount expended during fiscal year	912 [illegible]
July 1, 1885, amount available	587 [illegible]

COMMERCIAL STATISTICS.

Name of harbor, port of Tonawanda, N. Y.
Collection district, Buffalo, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	139	34, 209	144	34, [illegible]
Sailing vessels	355	131, 453	354	130, [illegible]
Total	494	165, 662	498	165, 467

Amount of revenue collected during the year ending December 31, 1884	$34, 402 30
Value of imports same year	228, 291 00
Value of exports same year	None.

Greatest draught of vessels, 13 feet.

N N 4.

IMPROVEMENT OF WILSON HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work, on January 28, 1885, in compliance with S. O. No. 6, A. G. O., January 8, 1885.

Colonel Robert's report upon this harbor, as furnished to me, is as follows:

> During the first seven months of the fiscal year ending June 30, 1885, there were no operations at this harbor. Available funds were practically exhausted during the fiscal year ending June 30, 1884, and no appropriation was made under the act of July 5, 1884.
>
> The citizens interested in the preservation of the work already done have recently repaired that part of the inner end of the east pier within the natural shore-line of the lake, and abutting on private property, where the decay of the old work rendered a breach imminent, and by such action have removed the danger of serious injury to the inner harbor. The existing channel between the piers carries a depth of about 8 feet for a narrow width, while the depth in the inner harbor is even less.

Since I assumed charge no work has been done, the appropriation having been practically exhausted.

Continuation of pier extension, and repair and dredging are the operations contemplated during the fiscal year ending June 30, 1887.

Money statement.

July 1, 1884, amount available	$133 25
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	92 85
July 1, 1885, amount available	40 40
Amount (estimated) required for completion of existing project	50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Wilson, N. Y.
Collection district, Niagara, N. Y.
Nearest light-house, Olcott, N. Y.
Nearest work of defense, Fort Niagara, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	1	190	1	190
Sailing vessels	17	891	18	930
Total	18	1,081	19	1,120

Amount of revenue collected during the year ending December 31, 1884	$951 64
Value of imports same year	535 71
Value of exports same year	89 81

Greatest draught of vessels, 10 feet 6 inches.

N N 5.

IMPROVEMENT OF OLCOTT HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with S. O. No. 6, A. G. O., January 8, 1885.

Colonel Robert's report upon this harbor, as furnished to me, is as follows:

> The last appropriation for this harbor was made March 4, 1881, and was expended in the construction of a shore-arm to the west pier.
>
> No expenditures were made in the first seven months of the fiscal year ending June 30, 1885, as no funds were available. The piers have been carried to about the 9-foot curve in the lake, and a channel carrying about 7 feet connects the deep water of the lake with the inner harbor.
>
> A large part of the superstructure built fourteen years ago is much decayed and will need thorough repairs at an early date for the general preservation of the work.
>
> All of the $30,000 of the unappropriated balance of the original estimate will be re-

quired to complete the project, leaving the cost of the necessary repairs to superstructure to be provided for by additional estimates.

The commerce of the harbor is trifling and its requirements very limited.

No work has been done since I assumed charge.

Money statement.

Amount (estimated) required for completion of existing project	$30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	30,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Olcott, N. Y

Collection district, Niagara, N. Y.

Nearest light-house, Olcott, N. Y., a fixed white light of the sixth order near the head of the west pier.

Nearest work of defense, Fort Niagara, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	46	8,915	46	8,915
Sailing vessels	22	312	20	239
Total	68	9,236	66	9,154

Amount of revenue collected during the year ending December 31, 1884....	$115 32
Value of imports same year	149 00
Value of exports same year	9,815 00

Greatest draught of vessels, 9 feet 6 inches.

N N 6.

IMPROVEMENT OF OAK ORCHARD HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with Special Orders No. 6, Adjutant General's Office, January 8, 1885.

Colonel Robert's report upon this harbor as furnished to me is as follows:

During the first seven months of the fiscal year ending June 30, 1885, the superstructure of the entire west pier, from its outer end to just inside the shore-line, or a distance of 1,072 linear feet, was entirely rebuilt. The old work was removed to the line of sound timber, or about 2 feet above zero, and the superstructure rebuilt to a height of 5 feet above zero, and the deck covered with new plank.

The stone in the old work was sufficient to fill the new. The cost of tearing down the old and decayed timber and replacing it with new was, exclusive of office expenses, $6.67 per linear foot, of which amount $3.15 per linear foot was for local superstructure, labor, tools, tug and scow hire, and $3.52 per linear foot for material used in rebuilding the work, such as timber, drift-bolts, and spikes. The work was done by hired labor, and the purchase of the principal material under competitive proposals submitted in response to circular letters addressed to dealers in the materials required. That part of the superstructure of the east pier outside of the shore-line, about 900 feet long, is much decayed, and will require rebuilding in the near future. The general commerce of Lake Ontario is benefited by the improvement of Oak Orchard Harbor, for, being almost centrally located between the mouths of the Niagara and Genesee rivers, it is of value to vessels seeking refuge between these points during fall gales. The original project for the improvement of this harbor recognized its position as of value in this connection.

No work has been done since I assumed charge, as the appropriation as practically exhausted. A continuation of pier extension and reairs, with such dredging as may be necessary, are the operations conemplated during the fiscal year ending June 30, 1887.

Money statement.

uly 1, 1884, amount available	$3,000 00
mount appropriated by act approved July 5, 1884	5,000 00
	8,000 00
uly 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,777 53
uly 1, 1885, amount available	222 47
Amount (estimated) required for completion of existing project	92,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Oak Orchard, N. Y.
Collection district, Genesee, N. Y.
Nearest light-house, Oak Orchard, N. Y., a fixed white light of the fourth order at the end of the west pier.
Nearest work of defense, Fort Niagara, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	4	97	4	97
Sailing vessels	16	1,173	7	527
Total	20	1.270	11	624

Amount of revenue collected during the year ending December 31, 1884	$2,037 86
Value of imports same year	119 18
Value of exports same year	None.

Greatest draught of vessels, about 12 feet.

N N 7.

IMPROVEMENT OF CHARLOTTE HARBOR, NEW YORK.

I relieved Lieut. Col. Henry M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with Special Orders No. 6, Adjutant-General's Office, January 8, 1885.

The report upon this harbor, as furnished me by Colonel Robert, is as follows:

During the first seven months of the fiscal year ending June 30, 1885, operations at this harbor consisted in the work done under a contract with James B. Donnelly, dated August 29, 1884, for the construction of 350 linear feet of pier extension. The work accomplished under this contract was limited to the partial formation of random stone foundations for the pier extension to be built. The superstructure, covering about 1,300 linear feet of the east pier, is in a very decayed condition, and will probably require rebuilding at an early date; the estimated cost of such repairs is about $13,000.

The superstructure of a large part of the west pier, although in better condition than the east pier, will require extensive repairs in the near future. Charlotte Harbor is the port of entry for the city of Rochester, N. Y., and its importance fully justi- the extension of its present improvement to meet the requirements of commerce re- sulting from the deepening of the Welland Canal, which when completed will require the admission into Charlotte Harbor of vessels drawing 14 feet of water. The appro- priations for this harbor have in the past been expended in pier extensions and re- pairs, nothing having been expended in dredging. By comparing the present depth of the channel between the piers and its depth, as shown by the surveys of 1845, or forty years ago, it is seen that the principal change has occurred in the vicinity of the intersection of the lake shore with the west pier. At this place a shoal about [illegible] feet long and 250 feet wide has formed, extending from the west pier to about mid- channel, with from 1 to 3 feet less water than existed in 1845. Over the remaining area of the channel the depth seems to have decreased about 1 foot. The shoaling above referred to is undoubtedly caused by the sand which is blown over the west pier from the sandy area west of the pier being deposited in the channel between the piers. To improve Charlotte Harbor, so as to make it at all times available for ves- sels drawing 14 feet of water, would require, after making the necessary allowance for loss of depth from waves, that the other end of the channel have a depth of [illegible] feet, decreasing to about 15 feet after passing well within the piers. If such a chan- nel is made 300 feet wide for that part outside of the pier, about 2,400 feet, and [illegible] feet wide for that part within the piers and outside the natural lake-shore line, it will require the removal of about 150,000 cubic yards of material. To attempt the main- tenance of a channel of these dimensions by means of pier extension would require the piers to be carried at least to the 18-foot curve in the lake, or a distance of about 1,100 feet beyond the extension which will be reached under the present contract. The aggregate cost of such dredging and pier extension would be about $150,000, of which $40,000 would be for dredging and $110,000 for pier extension. Experience has shown the uncertainty of maintaining by pier extension alone a channel of from 14 to 18 feet in depth, even after it has been once fully obtained by dredging, and that periodical dredging must be frequently resorted to, even though the deepened chan- nel has received protection from adjacent piers. In view of this it is deemed worthy of consideration whether at much less cost a more efficient channel of entrance could not be maintained at this harbor by less pier extension and the more frequent deep- ening of the channel by dredging.

Work was resumed under Donnelly's contract of August 29, 1884, on June 11, 1885, the delay having been caused by the late opening of navigation. The time for the completion of the contract was June 30, but an extension was granted until August 31, 1885.

Up to the close of the fiscal year the only work done since the opening of navigation was the framing of about one and one-half cribs. The work under contract is 200 linear feet extension to the west pier, and 150 linear feet extension to the east pier, and when completed will leave the ends of the piers at the 13-foot curve in the lake, with the east pier 150 feet shorter than the west one. The shoal in the channel referred to above by Colonel Robert will probably not increase in future, as the grounds adjacent to the west pier are already largely covered with buildings, and grass and trees have been planted. Along the channel-faces of both piers are guide-piles, which were driven when the cribs were sunk, whose tops have long since rotted off. There are 182 along the west pier, and 121 along the east pier. Being below water they are dangerous to vessels, and should be removed. The estimated cost of removal is $1,515. Continuation of pier extension or dredging and repairs to superstructure are the operations contemplated during the fiscal year ending June 30, 1887.

Money statement.

July 1, 1884, amount available		$2,429 94
Amount appropriated by act approved July 5, 1884		20,000 00
		22,429 94
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,652 58	
July 1, 1885, outstanding liabilities	222 81	
		2,875 39
July 1, 1885, amount available		19,554 55

Amount (estimated) required for completion of existing project........	$99,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	99,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Charlotte, N. Y.

Collection district, Genesee, N. Y.

Nearest light-house, Genesee, N. Y. (at Charlotte), a fixed red light of the fourth order on crib, 300 feet inside of outer end of west pier. Forts Niagara and Ontario, N. Y., are the nearest works of defense.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	298	83,952	302	83,544
Sailing vessels........	500	109,899	502	109,314
Total	798	193,851	804	192,858

Amount of revenue collected during the year ending December 31, 1884....	$122,595
Value of imports same year........	792,802
Value of exports same year........	764,403

Greatest draught of vessels, about 12 feet.

N N 8.

IMPROVEMENT OF PULTNEYVILLE HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with Special Orders No. 6, Adjutant-General's Office, January 8, 1885.

Colonel Robert's report on this harbor, as furnished to me, is as follows:

During the first seven months of the fiscal year ending June 30, 1885, operations have been confined to the repair of the west pier. The work was done by hired labor and the use of material on hand, and consisted in raising from 2 feet to 3 feet the east wall of the superstructure, covering 98 linear feet of the west pier near its outer end.

The appropriation of $4,000, August 2, 1882, completed the estimated amount required for the completion of the existing project. As stated in the annual report of the officer in charge for the fiscal year ending June 30, 1884, the shoaling between the piers has reduced the available depth of channel to about 7 feet, while the channel along the shore arm of the west pier has shoaled so as to leave an available depth of from 4 feet to 7 feet. If it is desired to continue the improvement of this harbor so as to give an available depth between the piers and alongside of the shore arm of the west pier of 10 feet at low water, it will be necessary to provide for the exclusion of sand from the channel by means of construction, cutting off the shallow area at the south end of the harbor, and then redredging the channel between the piers and along the shore arm of the west pier. As stated in the last Annual Report, the estimated cost of this work would be about $30,000. Should it be found necessary to extend the present pier to the 12-foot curve in the lake, in order to maintain a 10 foot channel, the cost of such pier extension would be about $50,000, in addition to the $30,000 formerly named for the formation and protection of the inner channel. The commerce of this harbor, as shown by its commercial statistics, is small.

Since I assumed charge of this harbor no work has been done, the appropriation having been practically exhausted.

Money statement.

July 1, 1884, amount available	$[illegible]
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	214 [illegible]
July 1, 1885, amount available	17[illegible]

{ Amount that can be profitably expended in fiscal year ending June 30, 1887, provided channel is to be deepened .... 30,000 [illegible]
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Putneyville, N. Y.
Collection district, Genesee, N. Y.
Nearest light-house, Big Sodus, N. Y.
Nearest work of defense, Fort Ontario, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	2	26	3	[illegible]
Sailing vessels	12	666	14	[illegible]
Total	14	692	17	[illegible]

Amount of revenue collected during the year ending December 31, 1884	$622 [illegible]
Value of imports same year	83 [illegible]
Value of exports same year	None.

Greatest draught of vessels, about 6 feet.

N N 9.

IMPROVEMENT OF GREAT SODUS HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with Special Orders No. 6, Adjutant-General's Office, January 8, 1885.

Colonel Robert's report upon this harbor, as furnished to me, is as follows:

During the first seven months of the fiscal year ending June 30, 1885, operations at this harbor consisted in the work done under a contract with Messrs. A. F. Chapman & Co., dated August 27, 1884, for the construction of 200 linear feet in extension of the east pier, and about 200 linear feet of the breakwater extension. The work accomplished under this contract was limited to 211 linear feet of breakwater, connecting the previous east end of the east breakwater with the shore protection recently constructed by the Charles Point Association, and the partial formation of the random stone foundation for the pier extension to be built under the above-named contract. The erosion of Charles Point had produced an opening of over 200 feet between the east end of the east breakwater and the shore line, and through this opening, during northeasterly gales, considerable drift was carried into the bay forming the inner harbor. The closure of this gap was accomplished by cribs 50 feet in length, and about 4½ feet in height. About 500 linear feet of the east and 400 linear feet of the west pier superstructure are much decayed and will require rebuilding in the near future at an estimated cost of about $2,000. The superstructure of the east breakwater will also require minor repairs.

The plan for deepening the Welland Canal to 14 feet made necessary a revision of the principal ports of entry on Lake Ontario to adapt them to the increased requirements of lake commerce. This expansion of the original project applied to the harbors of Charlotte, Great Sodus, Little Sodus, and Ogdensburg will, in addition to increased pier extension, require more than 500,000 cubic yards of dredging. The dredges available for work on Lake Ontario are so small in number as to leave the benefits of competition in prices almost without value, while their capacity limits their availability to only ordinarily hard dredging. The above-named quantity of dredging would keep a dredge employed during the available working season about ten years, and from similar experience elsewhere it is highly probable that the Government could build and operate a suitable dredge upon these harbors, so closely related to each other, with great economy in the expenditure to be made, and to the very positive advancement of the work to be done.

A. F. Chapman & Co., resumed work under their contract of August 27, 1884, on May 12, 1885. The term for the completion of the contract was June 30, but was extended to July 15, 1885. Under this contract the following materials were used in the extension of the east breakwater:

White-pine timber and plank	feet, B. M.	46,253
Stone filling	cubic yards	324½
Screw-bolts and washers	pounds	1,366
Drift-bolts	do	2,532
Spike	do	806

Up to the close of the fiscal year four cribs of the east pier extension, each 50 feet long, 20 feet wide, and 12½ courses high, had been sunk on their riprap foundation, and the superstructure was in progress. The following materials were used:

Hemlock timber and plank	feet, B. M.	74,360
White-pine timber and plank	do	44,720
Stone riprap	cubic yards	374.3
Stone filling	do	986
Screw-bolts and washers	pounds	2,715
Drift-bolts	do	9,497
Spike	do	363

The completion of this contract will leave the end of the east pier at the 9-foot curve, and 150 feet shorter than the west pier, which ends at the 14-foot curve.

The channel at the entrance to the harbor is shallow, and a large amount of dredging—about 200,000 cubic yards—will be required to permanently improve it. Heretofore the excavation has been limited, from lack of funds, to the west half of the space between the piers, which are 460 feet apart. The material is fine sand, which flows readily, and until the entire area shall be deepened no permanent channel can be made. At present the channel is about 100 feet wide next to the west pier, with a governing depth of 9 to 10 feet at extreme low water. The closing of the Charles Point Gap will have some effect in keeping the channel open. This may be further aided by additions to the existing system of sand fences at the junction of the beach with the west pier, where large quantities of sand have been blown into the channel.

The cost of the extension will be about $300.

The superstructure is decayed and needs rebuilding over 500 linear feet of the east pier and 400 linear feet of the west pier. A portion of the east breakwater also needs repairs. The estimated cost is about $15,000.

A continuation of the pier extension, and maintenance, and dredging are the operations proposed for the fiscal year ending June 30, 188[illegible].

Money statement.

July 1, 1884, amount available		$4,30[illegible]
Amount appropriated by act approved July 5, 1884		10,0[illegible]
		14,30[illegible]
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,533 91	
July 1, 1885, outstanding liabilities	4 80	
		7,53[illegible]
July 1, 1885, amount available		6,77[illegible]
Amount (estimated) required for completion of existing project		65,0[illegible]
Amount that can be profitably expended in fiscal year ending June 30, 1887		65,0[illegible]
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Name of harbor, Great Sodus, N. Y.

Collection district, Oswego, N. Y.

Nearest light-house, Big Sodus, N. Y., a fixed white light of the fourth order, varied by a white flash every two minutes, on a bluff three-fifths mile west of entrance to bay. A fixed white light of the sixth order 180 feet inside of outer end of west pier, and a fixed red light of the sixth order at elbow of west pier. Nearest work of defense, Fort Ontario, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	8	685	5	[illegible]
Sailing vessels	61	9,515	56	[illegible]
Total	69	10,200	61	[illegible]

Amount of revenue collected during the year ending December 31, 1884	$29,469 [illegible]
Value of imports, same year	165,439 [illegible]
Value of exports, same year	48,620 [illegible]

Greatest draught of vessels, 11 feet.

N N 10.

IMPROVEMENT OF LITTLE SODUS HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with Special Orders No. 6, Adjutant-General's Office, January 8, 1885.

Colonel Robert's report upon this harbor, as furnished to me, is as follows:

> During the first seven months of the fiscal year ending June 30, 1885, operations at this harbor consisted in the work done under a contract with James B. Donnelly, dated August 29, 1884, for the construction of 200 linear feet of west pier extension.

The work accomplished under this contract was limited to the partial formation of random stone foundations for the pier extension to be built.

The piers have been extended to about the 12-foot curve at low water, and the channel between the piers dredged to a depth of 14 feet. The deepening of the channel has not been carried beyond the outer ends of the piers, and a shoal carrying less than 14 feet at extreme low water intervenes between deep water in the lake and the channel between the piers. The shelter which this harbor obtains from the east and northeast is such as probably to remove the necessity for an extension of the east pier as far lakeward as will be required on the west pier.

The time for the completion of the work under Donnelly's contract expired June 30, at which date the riprap foundation was in progress; two cribs of 14½ courses each had been sunk, one crib was ready to sink, and the fourth crib had been built to 11½ courses. In the two cribs which were sunk and in their foundation the following materials were used:

Hemlock timber and plank	feet, B. M.	44,360
White-pine timber and plank	do	25,200
Stone foundation and riprap	cubic yards	336
Stone filling	do	599.1
Screw-bolts and washers	pounds	1,842
Drift-bolts	do	6,016
Spike	do	160

The completion of the work called for under this contract will extend the west pier to the 13½-foot curve, making it 300 feet longer than the east pier, which ends at the 11½-foot curve. The dredged channel between the piers has a depth of 14 feet at extreme low water, but ends at 700 feet inside the end of the west pier, beyond which point no dredging has ever been done. A shoal carrying 12 to 14 feet of water lies between the ends of the dredged channel and the 16-foot curve in the lake outside. The material of this shoal is mainly hard clay. A gap of 200 feet was left between the east end of the east breakwater and the shore, which should be closed. The rapid erosion of the east point will then be checked, and the flow of water through the channel between the piers will be increased. Continuation of pier extension closing the east gap and dredging are the operations proposed for the fiscal year ending June 30, 1887.

Money statement.

July 1, 1884, amount available		$4,116 02
Amount appropriated by act approved July 5, 1884		10,000 00
		14,116 02
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$1,868 46	
July 1, 1885, outstanding liabilities	3,283 68	
		5,152 14
July 1, 1885, amount available		8,963 88
Amount (estimated) required for completion of existing project		45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		45,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Name of harbor: Little Sodus, N. Y.
Collection district: Oswego, N. Y.
Nearest light-house: Fair Haven, N. Y; a fixed white light of the fourth order near the head of the west pier.
Nearest work of defense: Fort Ontario, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	26	3,635	14	1,[illegible]
Sailing vessels	205	27,043	187	26,1[illegible]
Total	231	30,678	201	2[illegible]

Amount of revenue collected during the year ending December 31, 1884	$28,964 95
Value of imports same year	159,541 00
Value of exports same year	208,471 00

Greatest draught of vessels, 12 feet.

N N 11.

IMPROVEMENT OF OSWEGO HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work, on January 28, 1885, in compliance with Special Orders No. 6, Adjutant-General's Office, January 8, 1885.

Colonel Robert's report upon this harbor, as furnished to me, is as follows:

During the first seven months of the fiscal year ending June 30, 1885, operations have consisted in dredging of the inner harbor at the mouth of the Oswego River, the partial building of a spur to the west breakwater, to be placed near the entrance to the harbor, and the repair and rebuilding of a part of the superstructure of the west breakwater. The dredging was in continuation of the work done during the fiscal year ending June 30, 1884, under the agreement made September 5, 1883, with Franklin Lee; 1,929 cubic yards of material were removed, or an aggregate under the agreement of 34,124 cubic yards.

The dredge was further engaged during an aggregate working time of one hundred and sixteen hours at the rate of $10 per hour, in excavating the trenches for the foundation of the spur, and in removing injured and submerged parts of the breakwater under repair.

Under a contract with James B. Donnelly, dated August 29, 1884, the proposed spur to the west breakwater, described in the Report of the Chief of Engineers, 1884, page 2149, was built to a height of 23¼ feet. By the terms of the contract the spur was to be completed by November 1, 1884. The contractor, finding that the lateness of the season and the continued rough condition of the lake would operate against the placing and the completion of the spur within the time required by the contract, made application on October 17, to the officer in charge, for such an extension of time as would permit the work to be completed early in the season of 1885. The desired extension was made to June 15, 1885. The United States prepared the foundations for the proposed spur by excavating trenches about 25 feet wide and 5 feet deep, or to a firm bottom, along the lines of the spur, and then filling these trenches with stone to 21¼ feet below the zero of the gauge, or to about the height of the natural lake bed at the site of the proposed spur; 265.12 cords of stone were placed in the foundation. This work was done by hired labor and purchase of material in open market. The rebuilding of the superstructure was in accordance with the plan set forth in Report of the Chief of Engineers, 1884, page 2144. The work was done by hired labor and the purchase of the principal material under competitive proposals submitted in response to circular letters addressed to dealers in the materials required. The rebuilding of the superstructure, on the parapet plan, covered 2,970 linear feet of the western part, and 570 linear feet of the eastern end of the west breakwater, or an aggregate of 3,540 linear feet. Upon these repairs 1,700,000 feet, B. M., of white pine timber, and 292,000 feet, B. M., of cresoted Georgia pine were used. The latter was applied to the construction of the decking of the parapet, and comprised the upper tier of cross-ties, the deck-joists, and the plank covering of the deck—the white-pine timber costing from $15.35 to $16.70 per M feet, B. M.; the cresoted timber costing $44 per M feet, B. M., delivered in canal-boats at Oswego. The cost of rebuilding the superstructure, on the parapet plan, over the 3,540 linear feet of the west breakwater above described was as follows:

Tools and supplies	$1,592 23
Timber	40,803 78
Iron	5,811 85
Stone	4,560 61
Labor, including local superintendence	34,196 68
Hire of scows and tugs	2,186 23
Office expenses and general superintendence	1,577 28
Total	90,728 66

Or at a cost, including office expenses and superintendence, of $25.63 per linear foot; or, excluding office expenses, at a cost of $25.18 per linear foot. In the eastern 570 linear feet built no creosoted timber was used and the comparative newness of the work was such as to remove the item of cost due to cutting the old work down to the water-surface, which obtained on the western 2,970 linear feet built; for these reasons it would be fair to assume that the cost per linear foot of building the eastern 570 feet was about one-half the cost per linear foot of building the western 2,970 feet. On this basis the cost of the complete rebuilding of the superstructure on the parapet plan would be $27.87 per linear foot, including office expenses and superintendence, or excluding office expenses and superintendence $27.42 per linear foot; the estimated cost of the work was $30 per linear foot. During a severe gale from the northwest, early in November, the breakwater was injured at a point about 500 feet east of the angle made by the shore-arm with the west breakwater; the injury covered 145 linear feet, or a length of four cribs. Over this length of breakwater the superstructure, together with the substructure to a depth of about 12 feet below the water-surface, was forced southward, or into the harbor, from a few inches to 3 feet. Superficially the effect of this displacement was to distort the previous lines of the work; to practically remove the stone through the bottom of the displacement, and produce a partial fracture on the lake face of the timbers of the superstructure at the point of junction of the displaced work with the intact work.

The decking of both parapet and banquette remained in place and only suffered from the distortion of the work. The injury to the breakwater was such as to make it highly probable that subsequent gales would produce a breach at the site of the injury, which, if unarrested, would spread to an unlimited extent. The lateness of the season precluded a systematic repair of the injury, and all effort was concentrated upon limiting further injury to that part of the work already impaired. To accomplish this very heavy bulkheads were built entirely across the banquette and parapet at the eastern and western limits of the injury, or 145 feet apart, and in such a manner as to permit all of the injured part of the breakwater being carried away, and at the same time checking the destruction at the bulkheads.

Early in December a severe gale from the northwest swept through the breakwater between the bulkheads leaving a clean opening in the work 140½ feet in length, and from 8 to 12 feet below the surface of the water.

Since the formation of this breach the work has been subjected to unusually heavy gales, but so far the bulkheads have successfully held the breach within the limits of the first injury. The site of the foregoing described injury to the west breakwater covers that part of the work repeatedly breached before, and especially the site of the injury of November, 1883, in which three cribs or 105 linear feet of breakwater were swept away to a depth of about 12 feet below water-surface. In repairing this injury, in the spring of 1884, the gap was closed by sinking cribs from 12 to 14 feet deep, and subsequently carrying the parapet over this new work. The injury of 1884 was due to the sliding off of these subtops upon the old work. The results of the past indicate that this part of the west breakwater, over a length of about 300 feet, is subjected to a force of wave action largely in excess of that impressed upon any other part of the work, and it is imperatively necessary that in subsequent repairs this part of the breakwater be given a stability in excess of that found necessary upon the remaining parts. The repairs should be carried to a greater depth than attempted before, the mass of the superstructure increased beyond that given to adjacent parts, and the substructure and superstructure so connected by iron plates as to make the two parts practically one. During the past season an effort was made to obtain data relating to the height, velocity, and force of the waves thrown upon the western part of the west breakwater.

Three dynamometers were attached to a vertical shaft and placed near the angle made by the shore-arm with the main breakwater; one dynamometer was placed at the water-surface; the second at 8 feet, and the third at 16 feet below the water-surface. They were arranged so as to present their discs directly to the seas; the area of the disc was exactly one-half a square foot. The height of the waves was deter-

[illegible] by a level placed upon the high lake bank west of the shore and direct waves upon the incoming waves. The height determined was thus ascertained when it was about [illegible] feet from the breakwater. The velocities were by the time required for the wave to sweep along the shore-arm of the breakw The results of such observation may be summarized as follows: During a stor from the northwest the waves attain a height of from 14 to 16 feet above the surface of the lake, with a velocity of from 3 to 4 miles per hour. The dynam placed at the surface of the water recorded a pressure of 400 to 600 pounds per foot; while the dynamometers placed respectively [illegible] and 16 feet below the wate face gave no indications of even a pressure of [illegible] pounds per square foot. Late in season a dynamometer was placed in proximity to the others, but attached to the and at an elevation of [illegible] feet above the water-surface; but one reading was obta in this position which was [illegible] pounds per square foot. The gales from which the readings were obtained were far from the most severe, and it is highly probable parts of the breakwater are subjected at times to a force of over 1,000 pounds p square foot.

In addition to the damages reported above by Colonel Robert others have occurred at the breach, with the exception of the washing of stone filling from the cribs, the tops of which had been carried aw The cribs are now gone to a depth of 4 to 8 feet below extreme low-wa level, and the stone filling to a depth of 8 to 14 feet below the same lev. The parapet for 100 feet on each side of the breach shows decided sig of yielding, but the timbers as yet seem to be unbroken.

At 300 feet west of the breach the platform deck is raised 6 inches a length of 50 feet. For 60 feet eastward of this latter position two tim bers are gone from the harbor face and some of the deck plank are bro ken. At a point 656 feet to the west of the east end of the west break water a partial breach exists. The deck plank and joists are gone from 25 linear feet of the half of the work next to the harbor face; two tim bers are gone from the harbor face and the stone filling is washed ou to a depth of 4 feet. A breach may be expected at this point next fal The amount required for the repairs above mentioned is, for their pre ent condition, $80,000. On June 3, 1885, the spur-crib was sunk 25 feet west of the harbor entrance. It was completed June 30, 1885. The following expenditures were required:

Excavation for foundation, 1,250 cubic yards, at 30 cents	$375 00
Stone filling for foundation, 265.42 cords, at $4	1,060 68
Levelling stone in foundation	111 30
Hemlock for substructure, 216,560 feet, B. M., at $24	4,957 44
Oak for substructure, 8,640 feet, B. M., at $50	432 00
White pine for whole crib, 185,180 feet, B. M., at $28	5,185 04
Stone filling, 3,223 cubic yards, at $1.18	3,803 14
Tank iron, 15,102¼ pounds, at 4 cents	604 09
Bar iron, 3,300 pounds, at 3 cents	99 00
Screw-bolts, 21,435 pounds, at 4 cents	857 40
Wood-screws, 300 pounds, at 8 cents	24 00
Drift-bolts, 51,038 pounds, at 2¼ cents	1,148 35
Total	18,657 44

These expenditures have resulted in completing the crib itself. There will probably be necessary a strengthening of that portion of the breakwater which the crib adjoins in order to resist the increased wave action resulting from the construction, and also there will be needed some species of crib construction in the 10-foot space between the spur-crib and the breakwater to prevent the scour of the lake bottom in that space and consequent probable undermining of both structures. The estimated cost is $4,150. The shore-arm of the west breakwater is very much in need of repairs, as is also the west pier. The *old* west breakwater is in a dilapidated condition and should be repaired, for otherwise e material of which it is composed will be washed into the harbor and ecome a serious obstruction. This breakwater no longer forms a part the project for the improvement of the harbor, and I would recom- end that such legislative action be taken as to authorize its being rned over to private individuals, several of whom have asked for the ransfer, under condition of its being kept in repair according to plans pproved by the Engineer Department.

The appropriation being practically exhausted, no work is contem- lated during the coming season. Repair of the breakwater and west ier and extension of the east breakwater are the work contemplated or the fiscal year ending June 30, 1887.

Money statement.

uly 1, 1884, amount available		$10,303 83
mount appropriated by act approved July 5, 1884		80,000 00
		90,303 83
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$82,265 97	
July 1, 1885, outstanding liabilities	6,265 10	
		88,531 07
July 1, 1885, amount available		1,772 76
Amount (estimated) required for completion of existing project		70,682 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		150,682 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Name of harbor, Oswego, N. Y.

Collection district, Oswego, N. Y.

Nearest light-house, Oswego, N. Y. A fixed white light of the third order at the eastern end of the old west breakwater, a fixed red light of the fourth order on eastern end of outer west breakwater, a fog-bell attached.

Nearest work of defense, Fort Ontario, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departure.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	292	41,596	293	39,853
Sailing vessels	1875	390,085	1819	396,833
Total	2167	431,681	2112	436,686

Amount of revenue collected during the year ending December 31, 1884.	$629,594 78
Value of imports same year	5,647,042 00
Value of exports same year	1,247,537 00

Greatest draught of vessels, 12 feet 6 inches.

N N 12.

IMPROVEMENT OF SACKETT'S HARBOR, NEW YORK.

I relieved Lieut. Col. H. M. Robert, Corps of Engineers, of the charge of this work on January 28, 1885, in compliance with Special Order No. 6, Adjutant-General's Office, January 8, 1885.

Colonel Robert's report upon this harbor, as furnished to me, is as follows:

> During the first seven months of the fiscal year ending June 30, 1885, operations at this harbor were limited to the construction and placing of a crib 18 feet square and 9 feet high upon the shoal which extends southerly into the harbor from the east end of Ship House Point. The object of the crib was to define the entrance to the harbor, and also to furnish mooring facilities for the vessels while lying in the harbor. The work was done by hired labor, and purchase of material in open market, at an aggregate cost of $533.65.
>
> This harbor has a depth of 12 feet at low water over about 6 acres of its area, except a small part thereof, where the presence of rock in place limited the depth to a little less than 12 feet. It is considered that the present facilities of the harbor meet existing commercial requirements and that a further development of the project can with propriety be delayed. Under the action of northwest storms there is a strong movement of shore-drift along Ship House Point and from thence into the inner harbor, tending to impair the work of improvement already made. This drift could, with advantage to the harbor, be arrested by low jetties of crib-work, extending from near the eastern end of Ship House Point northerly into the bay to about the depth of 3 feet at mean stage of water. This work would cost about $2,000, and would not increase the estimated cost for the completion of the existing project.

No work has been done since I assumed charge, the appropriation having been practically exhausted.

Money statement.

July 1, 1884, amount available	$429 41
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	357 30
July 1, 1885, amount available	72 11
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	2,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Sackett's Harbor, N. Y.

Collection district, Cape Vincent, N. Y.

Nearest light-house, Sackett's Harbor, N. Y. A fixed white light of the fifth order on Horse Island, 1¼ miles west of town.

Nearest work of defense, Fort Ontario, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Class.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	12	1,017	11	1,024
Sailing vessels	117	5,098	119	5,132
Total	129	6,115	130	6,156

Amount of revenue collected during the year ending December 31, 1884	$2,311 98
Value of imports same year	22,330 72
Value of exports same year	3,774 00

Greatest draught of vessels 9 feet.

N N 13.

PRELIMINARY EXAMINATION OF NIAGARA RIVER, FROM YOUNGSTOWN TO LAKE ONTARIO, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., September 11, 1884.

GENERAL: In compliance with instructions contained in circular letter of September 4, 1884, from the office of the Chief of Engineers, I have the honor to report as follows:

The Niagara River from Youngstown to Lake Ontario, New York, is navigated only by small sail boats, and two passenger steamers which ply between Toronto, Canada, and Lewiston, N. Y. There are no obstructions to navigation, and no work of improvement of navigation is necessary.

There are no present or prospective demands of commerce.

The river is not "worthy of improvement."

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

N N 14.

PRELIMINARY EXAMINATION OF SCAJAQUADA [SCAJACUADA] CREEK, AT BUFFALO, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., September 11, 1884.

GENERAL: In compliance with instructions contained in circular letter of September 4, 1884, from the office of the Chief of Engineers, I have the honor to report as follows:

Scajacuada Creek, at Buffalo, N. Y., is "worthy of improvement."

I understand that in 1812 to 1815 all the war vessels of Lake Erie, including those of Perry's fleet, were built, fitted out, and sailed from this creek. It then opened upon Niagara River, with a depth of about 13 feet. It is now from 50 to 300 feet in width, with 12 feet of water at the mouth and about 6 feet in depth from half a mile from the mouth and for about 1 mile further up. There are some manufactories on the creek, and a large trade is done in connection with the Erie Canal.

The collector of customs is unable to give me any statement of the number of boats which ascend the creek, nor of the amount of revenue collected on its commerce. The following is such information as I could obtain from private firms who have factories on the creek.

The most serious obstructions to navigation are two permanent bridges, one of which is used by the New York Central Railroad Company and the other by the city of Buffalo.

At present about 4,000,000 feet of logs, valued at $60,000, are annually rafted up the creek, and it is claimed that about 8,000,000 feet of lumber would be shipped in vessels if the obstructions were removed and the channel dredged.

The firm of Pratt & Letchworth annually ship about 15,000 tons of various kinds of material, and would ship more if obstructions were removed.

Hall & Son ship annually the clay for 2,000,000 brick, the latter being of a value of from $80,000 to $100,000.

It is further claimed that if the obstructions were obviated and the channel dredged other large industries would be established on the banks of the creek.

The sum of $200 will be necessary for a survey to enable me to make a project and estimates of cost of improvements proper to be made.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF SCAJAQUADA (SCAJACUADA) CREEK, AT BUFFALO NEW YORK.

UNITED STATES ENGINEER OFFICE,
Buffalo, N. Y., January 17, 1885.

GENERAL: In compliance with instructions contained in Department letter of November 21, 1884, informing me of an allotment of $200 for a survey of Scajacuada Creek at Buffalo, I have the honor to submit the following report and accompanying tracing of the map, plotted from the notes of the survey:

Scajacuada Creek originally emptied directly into the open Niagara River. In 1812 to 1815 all of the war vessels of Lake Erie, including those of Perry's fleet, were built and fitted out on and sailed from Scajacuada Creek, which at that time had a depth of about 13 feet near its mouth. Buffalo Harbor and Black Rock Harbor did not then exist, and, indeed, there was no harbor on the south shore of Lake Erie which would admit vessels drawing more than 10 feet.

In 1819–1821 the question of the Erie Canal arose and there was quite a contest between Black Rock (now in the city of Buffalo) and Buffalo as to which should be the terminus of the canal.

Buffalo was selected; but although in 1825 the canal was extended to Buffalo, the fact that a vessel of greater draught than 7 feet could not get into Buffalo, but could enter Scajacuada Creek with a draught of 13 feet, induced the canal commissioners, aided by the General Government, to commence the construction of Black Rock Harbor. It is therefore to be seen that this creek was the most important harbor on Lake Erie up to 1825, and virtually up to 1843, when the General Government abandoned the construction of Black Rock Harbor and adopted a definite plan of improvement of Buffalo Harbor. The importance of the creek for purposes of navigation was recognized by the canal commissioners, who established a drawbridge over it and have maintained it as such to the present time.

About forty years ago a railroad company (the road is now a branch of the New York Central) and the city authorities obtained permission from the State of New York to erect permanent bridges above the drawbridge. Since then other permanent bridges have been constructed.

The creek has now a width varying from 41 feet at its mouth (between the abutments of the canal bridge) to 400 feet. Its extreme depth at its mouth is 14.3 feet, and at a mile above its mouth it has an extreme depth of 6.4 feet. Between these two points the depth varies between the above-mentioned limits.

There are a number of strong springs which empty into the creek and lways create a slight current. The rise and fall of the creek, irrespective of its own floods, which are not serious, corresponds in a modified egree with that of the lake at Buffalo. The difference of extremes is bout 4 feet.

From the upper Black Rock Harbor to the mouth of the creek the hip-canal has a minimum depth of 9 feet. The Black Rock ship-lock s 194 feet by 37 feet in the clear, with a draught of 11 feet 2 inches over the upper miter-sill, and 10 feet 2 inches over the lower miter-sill at ordinary stage. From the lock into the Niagara River there is a depth of from 10.5 to 14 feet.

The draught over the miter-sill of the lock, or 10 feet 2 inches, will, therefore, be the limit of the depth to be obtained in the creek itself. This depth can be obtained by dredging at a cost of 20 cents per cubic yard. The material to be dredged consists, to all appearance, of mud, clay, sawdust, and refuse, but there will undoubtedly be a number of logs and branches of trees encountered. The State and private individuals have for years used the creek as a dumping ground for dredged material.

Those most interested in the navigation of the creek complain of the permanent bridges. The bridges crossing the creek are:

(1) *Erie Canal Tow-path Bridge.*—Owned by the State of New York; at the mouth of the creek; small balance draw-bridge; span 41 feet in the clear; height of lower chord above water-level 8 feet.

(2) *New York Central Railroad Bridge.*—Main line, double track; an iron truss skew bridge; one span 129.5 feet long, 29 feet in width over all; lower chord 16.5 feet above water-level.

(3) *Niagara Street Bridge.*—Street cars, carriages, and foot passengers; owned by city of Buffalo; combination iron truss and girder; 50 feet 5 inches wide; 56.5 feet clear span; lower chord 16.5 feet above water-level. The city water main and the gas main are carried over the creek on a small truss connected with and on the east side of this bridge.

(4) *New York Central Railroad Bridge, Belt Line.*—Single track; wooden trestle 380 feet long, set on piles; in the center of the channel is a light Warren girder span of 29 feet; lower chord of deck beams 13 feet above water-level.

(5) *Malleable Iron Works Bridge.*—Carriage and foot bridge; owned by private corporation; wooden trestle 216 feet long, 13 feet wide, set on piles; shore-ends 7 feet above water-level rising to 15 feet above water-level at center, where there is a light wooden truss of 40 feet span.

(6) *Grant Street Bridge.*—Owned by city of Buffalo; carriage and foot bridge; wooden trestle 510 feet long, 18 feet wide, supported on piles, with a wooden truss of 32 feet span at 192 feet from north end; lower chord of span 17 feet above water-level.

(7) *New York Central Railroad Bridge, Belt Line.*—Single track; wooden trestle 331 feet long, set on piles. At 90 feet from the north end there is a wooden skew truss of 25 feet span; lower side of stringers 17 feet above water-level. At 60 feet above Grant Street Bridge there is a row of old piles, which are the remains of an old dam built by the State of New York to turn the freshets into the State ditch. The main of the "Jubilee Water-Works" (a private enterprise) crosses on the bottom of the creek, near the old dam.

If the navigability of the creek is to be restored, the first and most important step would be to require the owners of the permanent bridges to put in draws of about 40 feet in the clear.

The project for the improvement would then be to dredge a cha 1 mile long, 100 feet wide, and 10.5 feet deep. For convenience of co putation, the creek and the ship-canal are divided into sections. (Se map.) Furthermore, provision should be made for preventing any sa dust or dredged material from being dumped in the creek, and the own of lumber mills along the banks should be required to keep their lo out of the channel.

In reply to circular letter sent to the different firms interested in th creek, I received the following information. All of them state tha their business is injured by the permanent bridges. They all state tha increased dock-room and facilities are needed at Buffalo, and that th reopening up of Scajacuada Creek would supply that want.

The present commerce, as far as I can learn, amounts to—

3,000,000 feet of logs	$15,[illegible]
7,500,000 feet of lumber	1[illegible]5,[illegible]
19,000 tons clay	76,[illegible]
2,000 tons brick	6,[illegible]
1,000 tons coal	3,[illegible]
Miscellaneous shipments	2,[illegible]
Total	217,5[illegible]

It is claimed that if the bridges be provided with the proper draw and the creek dredged, the shipments, especially of lumber, iron, coal and clay, will be very largely increased, and that if the creek be reopened to navigation, many new industries will seek its banks for location.

ESTIMATE.

Dredging area A, 5,741 cubic yards, at 20 cents	$1,148 [illegible]
Dredging area B, 44,140 cubic yards at 20 cents	8,[illegible] [illegible]
Dredging area C, 69,814 cubic yards, at 20 cents	13,962 80
Removing 20 old piles, at $2 per pile	40 00
Contingencies	2,021 00
Total	26,000 00

The whole amount can be profitably expended in one season.

Very respectfully, your obedient servant,

EDWD. MAGUIRE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

N N 15.

PRELIMINARY EXAMINATION OF SALMON RIVER, AT AND BELOW FORT COVINGTON, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., October 4, 1884.

SIR: In compliance with your instructions, dated July 31, 1884, I have the honor to submit the following report of the result of an examination made by me, on the 16th and 17th ultimo, of the Salmon River at and below Fort Covington, N. Y.:

The Salmon River enters the Saint Lawrence 10 or 11 miles below Cornwall, Canada, and about 5 miles north of the boundary line. The portion of the river in Canada is navigable, a regular line of small steamers plying daily (two steamers a day during summer) between Cornwall and Dundee, at the present head of navigation of the Salmon

River, just north of the boundary. Fort Covington [illegible] 1 mile above Dundee on the same river, and was formerly the head of navigation. During the war of 1812 a large body of our Army wintered at Fort Covington, and when they left in the spring burned their bateaus to prevent their falling into the enemy's hands. Many of these bateaus, partially burned, sank in the river, and the obstructions caused sand deposits until the river for a mile below Fort Covington is not now navigable by boats drawing even 4 feet. Boats drawing 6 feet can ascend to Dundee, on the boundary line, in spite of the sunken bateaus.

A railroad was completed within the last year from Montreal to Fort Covington, and one is projected from Fort Covington to Malone, and thence into the iron region of the Adirondacks, but its construction is entirely dependent, I am informed, upon the improvement of the Salmon River below Fort Covington. The object of this last road is to enable the west-bound grain vessels instead of returning in ballast to take at a low rate some iron ore to western lake markets. At present the 6 miles of river below Dundee cannot be navigated at low water by vessels with a draught exceeding 6 feet.

There is no use in improving the upper part of the river beyond the capacity of the lower part. But I should think that the commerce involved justified improving this small reach of 1 mile of river so that whatever vessels could reach Dundee might ascend 1 mile higher so as to connect with the railroad at Fort Covington on American soil, provided there is no rock to remove.

The managing director of the railroad from Fort Covington to Montreal, whom I saw in the latter city, feels confident that the Dominion Government will improve the lower part of the river if the United States undertakes the improvement of the upper part. It would be of great benefit, however, if the river was navigable for vessels that can now reach Dundee.

Under these circumstances, I am of opinion that this improvment is worthy to be made, so far as it can be without excavating rock, to the extent of making it navigable for all vessels that can ascend to Dundee or the boundary-line.

A survey of this locality would require a careful examination for rock, which underlies the entire vicinity, so as to ascertain to what depth the river is capable of improvement. I would estimate the cost of the survey, maps, &c., at not to exceed $400.

As the river is not at present navigable above the boundary-line, the commerce affected by this improvement can be best estimated from what is stated above. The railroad to Montreal has been completed not quite a year, and the other roads are prospective and dependent upon the river being improved.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

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SURVEY OF SALMON RIVER, AT AND BELOW FORT COVINGTON, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., December 31, 1884.

SIR: I have the honor to submit the following report on the survey of the Salmon River, at and below Fort Covington, N. Y., just completed, under my direction, by Assistant Engineer L. Y. Schermerhorn.

The report of the preliminary examination of this locality, made by me personally, was submitted under date of the 4th of last October.

Of the 5 miles of the Salmon River below Fort Covington, 1 mile lies in the United States and about 4 miles in the Dominion of Canada. The survey developed the fact that the bars in our portion of the river were not probably formed by sunken bateaus, as stated in my preliminary report. The portion of the river in our territory, up to the railroad bridge in Fort Covington, is capable of being made navigable for boats drawing 12 feet, at an estimated cost of $54,000. But as $14,000 of this would be required for the 700 feet just below the railroad bridge, and this portion could be omitted without any serious injury to the improvement, I would propose to carry the improvement only up to Salmon street, in Fort Covington, which would cost, for an available depth of 12 feet, only $40,000.

If the river is made navigable only for boats drawing not over 9 feet the estimated cost in each of the above cases is reduced 50 per cent. The width of the channel would be 75 feet at the bottom, increasing to 100 feet width at the sharp bends.

The dredged material would have to be towed down the Salmon River and dumped into the Saint Lawrence in Canadian waters, but it is presumed that permission for this would be readily granted by the Dominion authorities. It is possible that it may be necessary to have the work done by Canadian dredges, in which case our own Government doubtless would remit any duties or charges on the dredging plant, just as is now done in case of Canadian timber imported for use in our breakwaters.

As stated in my preliminary report, the utility of this improvement is dependent upon the improvement of the lower part of the river outside of our territory. At the same time there would be no reason to improve the lower part of the river unless the upper portion were improved so as to make close connection between the railroad and deep water. Under such circumstances it would appear more prudent, after an appropriation is made by our Government, to hold it until the Chief of Engineers is satisfied that the Canadian authorities are going to improve the Salmon River from the boundary line to its mouth. Whatever depth of channel they dredge we should do the same.

I would then recommend the following project for the improvement of the Salmon River at and below Fort Covington, N. Y.

The river should be dredged from the boundary line up to Salmon street, in Fort Covington, a distance of about 4,300 feet, to a width of about 75 feet, except at sharp bends, where it should be increased to 100 feet to an available depth of 9 feet at low water, ultimately to be increased to 12 feet; provided the depth of the dredging in no case exceeds that which the Chief of Engineers is satisfied is to be attained on the lower portion of the river.

The cost of this project, if fully carried out, is shown in the following—

ESTIMATE.

Dredging 75,000 cubic yards soft clay and gravel, at 25 cents per cubic yard	$18,750
Dredging 33,000 cubic yards clay mixed with stones, at 50 cents per cubic yard	16,000
Superintendence and contingencies	5,250
Total	40,000

To obtain the preliminary depth of 9 feet will cost just one-half this sum, or $20,000.

There is forwarded herewith the report and map of the survey made by Assistant Engineer L. Y. Schermerhorn.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. L. Y. SCHERMERHORN ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., December 30, 1884.

SIR: I have the honor to submit the following report on the survey of the Salmon River at and below Fort Covington, N. Y.

Fort Covington is situated near the northwest corner of Franklin County, New York, and about 1 mile south of the boundary line between the State of New York and Canada.

The Salmon River heads in the Adirondack Mountains, about 35 miles southeast from Fort Covington, and discharges into the Saint Lawrence River. The distance by river from Fort Covington to the Saint Lawrence is about 5 miles, of which distance about 1 mile lies in the United States and the remaining 4 miles in Canada. The survey extended from the lower highway bridge at Fort Covington to the boundary line between the United States and Canada, or a distance by river of 5,900 feet.

The Salmon River and its affluents drain a water-shed of about 450 square miles, and furnish valuable water-power from dams at Malone, Brushton, and Fort Covington. Below Fort Covington the river is in ordinary stages practically slack water, and variations in its level are dependent upon the Saint Lawrence River. In freshets its banks are quickly filled, but the mountainous character and small area of its water-shed render such freshets of but short duration. At the breaking up of ice in the spring, ice gorges are formed just below Fort Covington, at the confluence of the Little Salmon. The banks of the river are exceedingly stable, and not a single instance of a caving or denuded bank occurs. The river bed consists of blue clay, both free from and mixed with stone, as shown on the profile in the accompanying map. Borings were made at frequent intervals, and in the parts of the river bed marked "blue clay" the bottom was quite soft, and the iron rods could be forced to the indicated depth with great ease. In the parts marked "clay and stone," the iron bars required heavy driving, but the resistance encountered was more due to stone than to the hardness of the clay with which the stones were associated. The freedom of the river bed from sand results from the stable character of its banks and bed, aided by the many mill-dams above Fort Covington, which, acting as settling basins, arrest material which otherwise would be carried to the lower reaches of the river.

In the war of 1812 Fort Covington was the base of supplies for General Wilkinson's army of about 7,000 men, operating on this part of the frontier. Upon the evacuation of this point, in February, 1814, it is stated that 328 bateaux, used for transportation, were burned at Fort Covington. It is locally reported that the remains of these boats are scattered on the river bottom at and below Fort Covington, and that the existing obstructions in the river are sand-bars and *débris* gathered about the hulks of the bateaux. No remains of these bateaux could be found during the survey, and the frequent borings failed to develop their existence below the river bed. These facts, taken in connection with the general absence of sand in the river bed, suggests an error in the local theory of the formation of the obstruction found in the river. There may be more manifest evidences of the wrecks of the bateaux and the formation of sand-bars in the Canadian part of the river, and it is possible that an exhaustive examination of the river between Fort Covington and the boundary line might develop some evidences of these bateaux, but enough is known to permit the statement that between Fort Covington and the boundary line the remains of the bateaux do not form an important part of the obstructions.

The recently completed United States and Canadian Railroad, which extends from Fort Covington northeasterly to the boundary line, connects Fort Covington with the railroad systems of Canada and the United States by branches of the Canada Grand Trunk Railroad, one connection reaching Montreal and another Rouse's Point, N. Y. An extension of the railroad from Fort Covington westward to Norwood is in process of construction; this extension will connect the previously described railroad lines with the western connections of the Rome, Watertown and Ogdensburg Railroad.

With the improvement of the Salmon River it is proposed to make Fort Covington a point of distribution by rail of coal received by water transit, and also for the water shipment of iron ore from the mines of Northern New York. These demands, together with the agricultural products of a productive belt of country tributary to such water and rail facilities, will, it is thought, make Fort Covington an important receiving and distributing point, and justify the expenditure by the National Government of the amount required to make the Salmon River navigable between Fort Covington and the boundary line. The improvement of the Salmon River between Fort Covington and the New York State line is only a part of the work necessary to permit the utilization of the foregoing described plan of water communication since that part of the river within the Dominion of Canada (about 4 miles) would require similar improvement to perfect the scheme anticipated by the promoters of this work. Some years ago the Canadian Government deepened, by dredging, the channel over some of the worst bars below the boundary line, and a small amount of commerce passes over that part of the river.

It is stated by parties interested in the general improvement of the Salmon River that the Canadian Government is ready to undertake the improvement of the river within their borders if that part of the river between Fort Covington and the boundary line is to be improved by the United States.

The general plan of improvement herein suggested is the formation of a dredged channel, 75 feet wide at bottom, with an available depth of 9 feet at low water, extending from the boundary line to the vicinity of the railroad bridge crossing at Fort Covington. After the completion of the above improvement, if the future development of the commerce of the river should indicate the necessity for a greater depth, the channel could be deepened to an available draught of 12 feet at low water.

It is probable that the full benefit of the improvement would obtain if instead of the dredged channel being carried to the railroad bridge, it were stopped at a point abreast of Salmon street. Either plan would allow of sufficient river front for railroad and dock facilities.

In the following estimates the respective cost of the several plans herein stated are given. At two points the curvature of the river is so great that the channel width should be increased to 100 feet for a short distance, as shown on the accompanying map.

ESTIMATE.

For a dredged channel about 5,000 feet in length, extending from the boundary line to the railroad bridge, 75 feet in width except at bends, and 9 feet available depth at low water, the estimated quantities and cost would be as follows:

55,000 cubic yards mud, soft clay, and gravel, at 25 cents	$13,750
18,000 cubic yards clay, mixed with stones, at 50 cents	9,000
Contingencies	4,250
Aggregate	27,000

For the same length and width of channel, dredged to an available depth of 12 feet at low water, the estimated quantities and cost would be as follows:

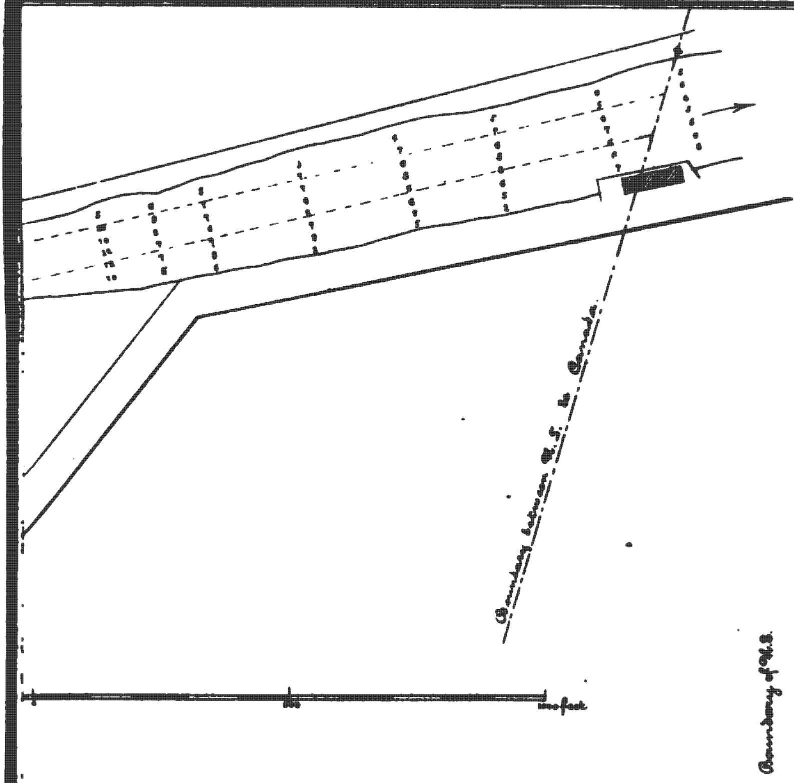
93,000 cubic yards mud, soft clay, and gravel, at 25 cents	$23,250
47,000 cubic yards clay, mixed with stones, at 50 cents	23,500
Contingencies	7,250
Aggregate	54,000

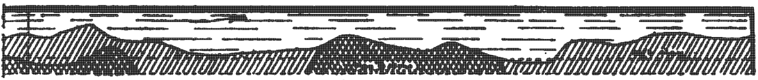
For a dredged channel about 4,300 feet in length, extending from the boundary line to a point abreast of Salmon street in Fort Covington, 75 feet in width except at bends, 9 feet available depth at low water, the estimate would be as follows:

40,000 cubic yards mud, soft clay, and gravel, at 25 cents	$10,000
13,000 cubic yards clay, mixed with stones, at 50 cents	6,500
Contingencies	3,500
Aggregate	20,000

For the same length and width of channel dredged to an available depth of 12 feet at low water, the estimate would be as follows:

75,000 cubic yards mud, soft clay, and gravel, at 25 cents	$18,750
32,000 cubic yards clay, mixed with stones, at 50 cents	16,000
Contingencies	5,250
Aggregate	40,000





Profile of mean depths.

Hor. = 1/20 of Ver. Scale.

Map of

non River

and below

vington, N.Y.

under direction of

l. Henry M. Robert

of Engineers

ermerhorn, Asst. Engr.

December 1884.

Henry M Robert
Lt Col Engrs

In the foregoing estimates the depth of dredging has been assumed as 1 foot greater than the depth of the channel to be made available, and 25 per cent. has been added to place measurement to reduce the quantities to scow measurement. In the calculation of quantities the side slopes were assumed at 2 horizontal to 1 vertical. All depths on the accompanying map are reduced to the stage of water in Salmon River corresponding to the stage of the Saint Lawrence with the gauge at Ogdensburg reading zero. This reduction to low water agreed closely with information obtained at Fort Covington as to the low-water stage of the river. The low-water stage of the Salmon River, herein referred to, is a plane 4.7 feet below the top of timber on D. E. Denneen's dock, near its northeastern corner.

The material removed from the river-bed in the formation of the channels should be placed in dump scows and towed to deep water in the Saint Lawrence. To cast the material over on each side of the channel would quickly result in the soft material sliding back into the channel and obliterating the improvement made.

Very respectfully, your obedient servant,

L. Y. SCHERMERHORN,
Assistant Engineer.

Lieut. Col. HENRY M. ROBERT,
Corps of Engineers, U. S. A.

N N 16.

PRELIMINARY EXAMINATION OF MOUTH OF SALMON RIVER, ON LAKE ONTARIO, NEW YORK, WITH A VIEW TO MAKING A HARBOR OF REFUGE, ETC.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., February 7, 1885.

SIR: In compliance with your instructions, dated July 31, 1884, I have the honor to submit the following report of the result of an examination made by me on the 15th of September, 1884, of the "mouth of Salmon River, and the inner natural harbor thereat, on Lake Ontario, New York, with a view of making a harbor of refuge for vessels in distress and for purposes of commerce and navigation, New York."

Salmon River enters Lake Ontario about 20 miles east of Oswego, and Port Ontario is about 1 mile up the river.

Lieut. R. C. Smead, U. S. Army, September 20, 1836, made a report upon this subject, which is quite liberally quoted from by Colonel Blunt (pp. 290 and 292, Report of the Chief of Engineers, 1868). November 30, 1867, Col. C. E. Blunt reports fully upon the whole subject (pp. 289–293, Report Chief of Engineers, 1868). January 7, 1871, Lieut. B. D. Greene submitted a report and a map of his survey of the mouth of Salmon River (pp. 252 and 253, Report of the Chief of Engineers, 1871); and Maj. John M. Wilson, in his annual report for 1871, expresses his views of the case (p. 251, Report of the Chief of Engineers, 1871).

These reports exhaust the subject, and show that this locality has been already surveyed by the Government with a view to improvement. The last survey was made in 1870, by Lieut. B. D. Greene, Corps of Engineers, from whose report I extract the following:

> The village of Port Ontario, from which the port of entry derives its name, is situated upon the west bank of Salmon River, about 1 mile from its mouth. It consists of one storehouse, one store, one tavern, and six houses. Its only business is the receipt of a small quantity of lumber (ties and posts).
>
> The river below Port Ontario, excepting immediately at its mouth, is of sufficient depth, with a small amount of dredging, to admit vessels of any class.
>
> The village named Selkirk, at the mouth of the river, and upon its east bank, consists of a tavern and three houses, including the old light-house. This village has no business whatever, in fact, beyond the result of the natural process of decay. I think no change can be reported in either village since Colonel Blunt's report of 1867, or even Lieutenant Smead's, of 1836.

> Salmon River is of considerable magnitude for many miles above its mouth, and flows through a heavily-timbered section of country. Most of its timber, however, is shipped by the railroad, which crosses it near Pulaski, 5 miles from its mouth.
>
> * * * * * * *
>
> It scarcely seems reasonable that there is any urgent necessity for a harbor of refuge here, although two vessels were lost here last fall. A light kept here to warn vessels away would certainly be of advantage.
>
> Mexico Bay, as the angle at the eastern end of Lake Ontario is called, is a dangerous place for vessels in a storm. A light which would lead them to avoid it would save many; while, on the other hand, a harbor would save many of those which might unavoidably be driven into the bay.

Lieut. Col. John M. Wilson, in his annual report of 1871, in referring to this improvement, says:

> There seems to be no urgent necessity for a harbor of refuge at this place, Oswego and Sackett's Harbor being within reasonable distance.

The statements made in these reports would hold good to-day, excepting that there is not so much need of a harbor of refuge to-day as when these surveys and reports were made; and, on account of the increased draught of the vessels, a harbor of refuge to-day would cost probably double what it would have cost in 1871, when the latest of these reports was made. Then Port Ontario, on the Salmon River, a mile from its mouth, was of enough importance to be a port of entry, which it ceased to be some eight years ago. The railroads have entirely destroyed the prospects of the mouth of Salmon River as a shipping port. At present there is practically no commerce, a few fishing boats appearing to be the only vessels frequenting the harbor. Larger vessels could not enter the river at present; and I could not see or hear of any evidence that the improvement of the mouth of the river would make a port of any commercial importance.

Oswego Harbor, within 20 miles, on the one hand, and Sackett's Harbor, within 25 miles, on the other, seem to render unnecessary a harbor of refuge at this point, though of course every additional harbor is a convenience.

The cost of making the harbor serviceable has an important bearing on the question as to whether it is worthy of improvement. If a serviceable harbor of refuge could be made at this locality for $20,000, I think the improvement should be made, but if it were to cost $200,000 I would think the improvement unworthy of being made.

The Welland Canal is being deepened so as to pass vessels drawing 14 feet, and a harbor of refuge on Lake Ontario would now have to be planned on that basis instead of for 10 feet draught, as in the previous estimates for this harbor. This would require 4 feet greater depth of dredging, and would require the piers to extend out into water 4 feet deeper. A rough estimate, made on the spot, with the help of the map of the survey of 1870, convinced me that a harbor of refuge adapted to the requirements of modern vessels, as they will be when the enlargement of the Welland Canal is completed, could not be constructed at the mouth of the Salmon River for anything less than $300,000, and it might cost much more. I cannot learn of anything to justify such an expenditure.

For the reasons given, it is my opinion that the "mouth of Salmon River, and the inner natural harbor thereat, on Lake Ontario" is not worthy of improvement.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX O O.

IMPROVEMENT OF OGDENSBURG HARBOR ON THE RIVER SAINT LAWRENCE; OF HARBORS ON LAKE CHAMPLAIN, AND OF GRASS AND TICONDEROGA RIVERS, NEW YORK, AND OF OTTER CREEK, VERMONT.

REPORT OF MAJOR MILTON B. ADAMS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Ogdensburg Harbor, New York.
2. Grass River at Massena, New York.
3. Breakwater at Rouse's Point, Lake Champlain, New York.
4. Swanton Harbor, Vermont.
5. Plattsburg Harbor, New York.
6. Burlington Harbor, Vermont.
7. Otter Creek, Vermont.
8. Ticonderoga River, New York.

EXAMINATIONS AND SURVEYS.

9. Whitehall Harbor, New York.
10. Lake Champlain at Four Channels.
11. Mouth of the Saranac River at Plattsburg, New York.
12. Maquam Bay, Swanton, Vermont.

UNITED STATES ENGINEER OFFICE,
Burlington, Vt., July 25, 1885.

GENERAL: I have the honor to transmit herewith annual reports of river and harbor works in my charge for part of the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

M. B. ADAMS,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

O O 1.

IMPROVEMENT OF OGDENSBURG HARBOR, NEW YORK.

A project was formed for this improvement by a Board of Engineer Officers in 1868, which provided for dredging the channel of the Oswegatchie River below the bridge, deepening the channels along the city front on the Saint Lawrence River and across the bar northeast of the light-house, and the construction of pile piers to prevent the water of the Oswegatchie spreading over the bar, or shoal, between these channels.

The pile-work was only recommended in the event of the water of the Oswegatchie not following the lines of the deepened channels after the dredging had been completed.

Operations were carried on successfully, and the dredging, as provided for in the project, was completed in 1876. The piling was found unnecessary; consequently operations had been confined to dredging in the channels, which were left in good condition.

There was a suspension of operations for a few years after the completion of the project of 1868. A resurvey of the harbor was ordered in 1879, which being made in 1880, showed that there had been considerable shoaling of the channels during these four years of inactivity, and, furthermore, that the obstructions found in the channels were mainly due to sawdust and other waste products of saw-mills, which had been thrown into the Oswegatchie River in violation of local regulations forbidding it. The same nuisance existed during a part of the time when the channels were being improved, and gave rise to a correspondence between the officer in charge of the work and the city officials as early as 1871, at which time an attempt was being made by the mill-owners to cause a repeal of an ordinance prohibiting them from depositing their mill refuse in the river. Instead of the repeal being effected, the correspondence caused the city officials to bring suit against the offenders, and in a general term of the Supreme Court of the State of New York judgment was obtained against them to the amount of $500. Small as this judgment was in comparison with the damage to the channels, I am informed it was never enforced; consequently the injury continues in defiance of law.

The amount of the damage or shoaling, as shown by the survey of 1880, was 40,000 cubic yards, which it was estimated would cost $12,000 to remove, so as to place the channel in good condition again.

The estimated cost of the original project was $175,000, and there had been expended up to 1880, exclusive of $3,000 for a survey in 1852, $107,000, leaving $68,000 still due the general improvement, owing to the piling estimated for in the project not being required.

In 1882 it was recommended that the harbor be prepared for the admission of the largest vessels which will be able to pass the Welland Canal when completed, at an estimated cost of $76,000, as follows:

Outer bar, 1,500 feet by 400 feet by 3.1 feet, about 80,000 yards, at 30 cents per yard	$24,000
Inside and below bridge:	
Near Rome, Watertown and Ogdensburg Railroad Wharves, 1,150 feet by 300 feet by 3 feet, 40,000 yards, at 40 cents per yard	16,000
Oswegatchie mouth, 1,000 feet by 300 feet by 1.8 feet, 20,000 yards, at 20 cents per yard	4,000
Channel along city front, 7,200 feet by 150 feet by 4 feet, 160,000 yards, at 20 cents per yard	32,000
Total	76,000

This estimate was intended to provide for a depth of 15 feet in the channels and 16 feet over the outer bar.

By an act approved August 2, 1882, $10,000 were appropriated for this work, and operations were resumed that year, being directed towards the completion of the above modified project.

The first contract indicated, however, that the prices to be paid for the dredging should be increased above those given in the estimate, since the lowest price bid for the work as comprehended in that contract, and being along the city-front channel, was 22 cents per cubic yard.

Furthermore, a survey made in August, 1884, with borings, showed that hard clay and bowlders are to be encountered at depths of 14 to 24 feet in the Oswegatchie Channel, and at 12 to 17 feet depths in the city-front channel; consequently the contract made for this work, dated August 26, 1884, provides that nardpan, indurated or bowlder clay, or bowlders larger than 10 cubic feet, shall be paid for at the rate of 49⅜ cents per cubic yard, and ordinary material at the rate of 19¾ cents per cubic yard.

It would seem, therefore, that the estimate under the modified project should be increased in the last item—that for the channel along the city front—to 40 cents per yard, and the entire estimate to $108,000, instead of $76,000.

I can see no good reason why this item for the city-front channel should not be omitted from the estimate, since private and incorporate enterprise should, it seems to me, extend the channels along the city front, as the necessities of their business may require, after the Government secures two good channels, upper and lower, from deep water in the Saint Lawrence to the docks or wharves nearest to these respective entrances.

Under this view of the case the entire estimated cost would be reduced to $44,000, and 10 per centum for contingencies, or $48,400.

Operations thus far completed under the modified project were carried on under contracts dated December 13, 1883, and August 26, 1884. Under the first, the lower channel was completed so as to afford 15 feet of water from the Saint Lawrence River to the vicinity of the Central Vermont Railroad Wharves, being nearest that entrance, and under the second contract a good channel affording depths of 15 to 16 feet has been secured from the Saint Lawrence River to the vicinity of the Rome, Watertown and Ogdensburg Railroad Wharves and the ferry landing, they being the nearest to the upper entrance.

There were 35,345 cubic yards removed under the first contract, at a cost, including contingencies, of $9,510.72; and under the second, 48,194 cubic yards were removed, at a cost of $11,113.81, inclusive of contingencies.

Under the existing project, which contemplates the removal of about 300,000 cubic yards, there remain some 215,461 cubic yards yet to be removed, mostly in the city front channel.

There are $35,000 asked for this harbor, which could be advantageously expended during the fiscal year ending June 30, 1887, in dredging operations, in case the plan of improving the city-front channel is followed. Should the improvement of this channel be omitted from the scheme of improving the harbor, then $23,400 would be sufficient for the completion of the work.

Money statement.

July 1, 1884, amount available		$489 28
Amount appropriated by act approved July 5, 1884		15,000 00
		15,489 28
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,432 94	
July 1, 1885, outstanding liabilities	1,680 87	
		11,113 81
July 1, 1885, amount available		4,375 47
Amount (estimated) required for completion of existing project		83,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		35,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Ogdensburg, N. Y.
Collection district, Oswegatchie, N. Y.
Nearest light-house, Ogdensburg, N. Y.

Arrivals and departures of vessels during the year ending December 31, 1884.

Description.	Arrivals.		Departures.	
	Number.	Tonnage.	Number.	Tonnage.
Steamers	716	154, 771	654	156, [illegible]
Sailing vessels	555	91, 445	531	82, 16[illegible]
Total	1, 271	246, 216	1, 185	238, 5[illegible]

Revenue from customs	$221, 593 97
Value of imports	2, 114, 241 00
Value of exports	3, 977, 946 00

NATURE AND AMOUNTS OF IMPORTS DURING THE YEAR ENDING DECEMBER 31, 1884.

Lumber and timber, feet, B. M	43, 359, 661
General merchandise, tons	10, 928

NATURE AND AMOUNTS OF EXPORTS DURING THE YEAR ENDING DECEMBER 31, 1884.

General merchandise, weight not given, value	$3, 977, 946

The above information was obtained through the kindness of the collector of customs.

O O 2.

IMPROVEMENT OF GRASS RIVER AT MASSENA, NEW YORK.

There have been no operations under the above head during the fiscal year.

The project for this improvement appears in the Report of Chief of Engineers, 1881, pages 2457 and 2460; it contemplates the formation of a channel from the Saint Lawrence River to Massena Village, a distance of about 7½ miles by water, with a least width of 40 feet and a least depth of 4 feet, at an estimated cost of $12,000.

The items of the estimate are as follows:

Excavation at Rapids, 2,000 cubic yards, at $4 per yard	$8,000
Excavation at Haskell's Wharf, 1,500 cubic yards, at $1 per yard	1,500
Excavation at other points, 3,000 cubic yards, at 50 cents per yard	1,500
Contingencies, &c	1,000
Total	12,000

Under an appropriation of $3,000 for this work, proposals were invited in April, 1883, for the removal of 2,000 cubic yards of the obstructing material at Rapids, the first item as above, and in response only one bid was received, at the rate of $6 per cubic yard. It was evident, therefore, that it would cost $12,000 to make the improvement at that point, and that the funds available were only sufficient to remove one-fourth of that single obstruction. As no benefit could arise from the work unless completed, and as the work could be carried on more economically when the improvement of at least one place could be completed in one season's operations, an additional appropriation of $9,000 was asked for and no further action has been taken since.

The balance of the appropriation, after paying the cost of the advertising, &c., amounts to $2,948.60, which is now to the credit of the improvement.

In case additional funds become available for this work, it is expected to apply them in accordance with the original project, and the operations carried on would be dredging.

Money statement.

July 1, 1884, amount available	$2,948 60
July 1, 1885, amount available	2,948 60
Amount (estimated) required for completion of existing project	16,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	16,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Name of river, Grass River (at Massena), New York.

Collection district, Oswegatchie, New York.

Arrivals and departures during the year ending December 31, 1884: Four steamers, tonnage 200. Revenue from customs, $877.07. Value of imports, $4,519; character of imports, lumber; amount, 5,010 feet, board measure. Character and value of exports, thirteen horses, $1,695.

O O 3.

BREAKWATER AT ROUSE'S POINT, LAKE CHAMPLAIN, NEW YORK.

No operations were carried on under the above head during the fiscal year. The location and plan of construction for this improvement, as recommended by the Board of Engineers, has been approved.

Estimates of cost, drawing, and specifications, covering the construction of 800 linear feet (the shore section), were prepared and submitted for approval just at the close of the fiscal year.

As funds become available for this work, it is expected that they will be applied under the approved project, which contemplates the construction of a straight breakwater, of rubble and large stone, extending from Stony Point in the general direction of the southern point of the 6-foot curve south of Windmill Point, until the 18-foot curve is reached, a total distance of about 2,000 feet. The estimated cost of the breakwater is placed at $110,000. The amount appropriated for this work, $35,000, has been drawn upon slightly to meet certain incidental expenses connected with the preparation of the project, office expenses, &c. My predecessor expended $792.22, and I have expended $229.61 during the fiscal year.

The commercial statistics during the year ending December 31, 1884, could not be furnished by the collector of customs, on account of sickness in his clerical force. Quoting from the statement presented in connection with the preliminary examination and report (see Report of Chief of Engineers, 1884, page 2172) it is as follows:

> The local trade of the harbor at Rouse's Point is not very great; the receipts and shipments last year amounting to about 29,000 tons, involving the employment of about 225 lake vessels; but the harbor itself is a very important one, as all the water

traffic between Lake Champlain and Canada passes through it, every vessel entering or leaving the lake being required to report to the custom-house at this point. The commerce is very great, the value of the imports and exports last year being $4,490,305, while the import duties amounted to $719,398. The number of vessels used in carrying these imports and exports was 3,720. Including also those engaged in the local trade of the port, the whole number of vessels that made use of this harbor last year was 3,945.

Money statement.

Amount appropriated by act approved July 5, 1884	$35,000 00
July 1, 1885, amount expended during fiscal year	1,021
July 1, 1885, amount available	33,978
Amount (estimated) required for completion of existing project	110,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	76,021
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

SURVEY FOR BREAKWATER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., January 7, 1885.

SIR: I have the honor to submit the following report of the survey made last October for the purpose of determining upon the best location and plan for the breakwater at Rouse's Point on Lake Champlain, New York, together with a plan and estimate for the breakwater.

During the summer, while on Lake Champlain, I took advantage of the opportunity to talk with some of the best pilots and masters of vessels on the lake, in reference to the location of the breakwater that would be most convenient for protecting and handling tows. Practically all the commerce of Lake Champlain is carried on with tows of canal-boats averaging about 13, while occasionally reaching 40.

As a result of this I came to the conclusion that a shorter breakwater in mid-channel, so that tows could pass either side, would be more useful than a longer breakwater projecting from the shore. The natural location of such a breakwater would be on a line parallel to that connecting Stony Point and Windmill Point, and far enough (say, 1,000 feet) north of this later line to prevent the reflected waves from Stony Point getting behind the breakwater. Accordingly I directed careful soundings and borings to be made over the entire area that had a depth of 10 feet of water from the line joining Stony and Windmill points, 1,500 feet northward, extending the borings, however, to the shore at Stony Point.

The borings developed the fact that the bottom of the lake in this locality is generally soft mud, or soft clay, resting on a very hard bottom, appearing to Assistant Engineer Judson, who conducted the survey, to be either hardpan or soft rock. On the line 1,000 feet north of the line connecting Stony Point and Windmill Point the soft mud reaches a maximum depth of 14 feet, and averages over the proper position of the breakwater about 9 feet, making the average depth of the hard bottom at extreme low water 26 feet. On a line 750 feet south of this, though the water averages only 2 feet less, all the depth to the hard bottom is 7 feet less, reducing very much the expense of a breakwater on this line. To prevent the western end from being flanked by the reflected waves from Stony Point, the western half of the breakwater should be deflected so that the two arms would make an angle of

135 degrees. As a channel of about 400 feet width should be left on either side between the ends of the breakwater and the 12-foot curve, the breakwater on this location should not exceed 1,600 feet in length.

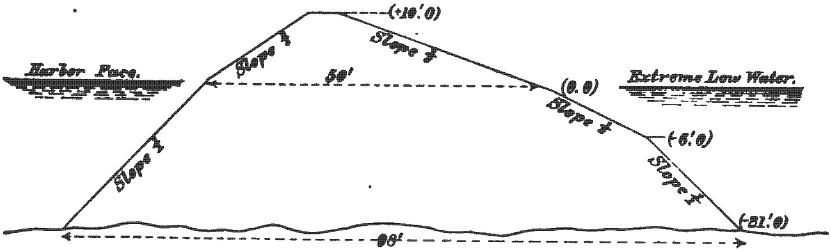
The direction of the channel and the line of the longest reach of the seas are practically coincident and nearly bisect the angle made by the two arms of the proposed breakwater. The longest reach of the waves at this point does not exceed 6 miles, and consequently they must be quite superficial. But the ice might occasionally overturn or destroy any light structure that would afford ample protection from the waves. The old breakwater at Swanton, Vt., though made of very heavy cribs, was overturned it is said by one of these ice thrusts.

After a careful consideration of the subject I am of opinion that for this locality it is better to construct the breakwater of random stone with a thickness of about 50 feet at extreme low water. The large size stone for covering the surface down to about 6 feet below low water on the lake face, would not exceed 10 per cent. of the entire quantity of stone. In commencing the breakwater I should allow the lake face above extreme low water to have a slope of 1 on 3, expecting the waves to somewhat modify it. An ice-thrust could do but little damage to such a breakwater. But to make it still more effective against the ice it may be found advisable to advance the salient angle, say 50 feet, by depositing stone in front of it so as to make an efficient ice-breaker.

Even if the ice shaved off the top it would be an inexpensive matter to restore the work, while in the case of cribs the damage would be very serious.

To allow boats to tie to the breakwater, I would propose to place piles as frequently as every 50 feet, which would in fact be almost necessary for use in constructing the breakwater. These piles could not easily be driven into the hardpan, but they could be weighted down until surrounded with sufficient stone to hold them.

In constructing the breakwater I should at first make a cross-section similar to the following, modifying it however as the work went on, if it seemed advisable:



Section of Proposed Breakwater.

The waves would doubtless alter these slopes eventually, and it is possible that additional stone would be required. To be on the safe side, I would consider the soft mud as water, estimate the stone at $1 per cubic yard, and make a liberal allowance for contingencies. Upon this basis I would estimate the breakwater to cost $75 per linear foot, net, or $120,000 for the 1,600 feet required, to which should be added $20,000 for contingencies and superintendence, giving a total of $140,000.

This estimate happens to be the same as submitted by me November 1, 1883, for a breakwater 2,000 feet long projecting from Stony Point. That plan was submitted, as stated therein, without any knowledge of the bottom. The recent survey shows that the soft mud on that line averages over 6 feet. As stated in that report, "the exact location and other details should be decided only after a careful survey, with borings of the locality." After such a survey I now submit the above plan as in my judgment best meeting the needs of commerce at the minimum of expense. There are forwarded herewith a report and map* of the survey made by Assistant Engineer William P. Judson.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. WILLIAM P. JUDSON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., December 10, 1884.

COLONEL: I have the honor to submit the following report on the survey of Rouse's Point Harbor, New York.

This harbor is situated at the outlet of Lake Champlain, 2 miles south from the boundary line between the United States and Canada. It forms the head of the river Richelieu or Saint John, which connects Lake Champlain with the river Saint Lawrence.

The survey was made between September 30 and October 10, 1884, and the map* of it, which is herewith submitted, shows the area which is to be sheltered by the proposed breakwater. This area is limited on the south by Stony Point, upon the New York shore, and by Windmill Point, upon the Vermont shore, which points separate the harbor from the open lake. It extends on the north to Fort Montgomery, which commands the passage of the river Richelieu. The area thus limited is about 1 mile wide by 2¼ miles long. Midway of this area the harbor is crossed by two lines of pile piers, which carry the tracks of the Central Vermont and the Portland and Ogdensburg railroads. Draw-bridges are built in these piers for the passage of vessels. The custom-house is located at the draw-bridges, and all vessels and tows of barges and canal-boats are required to stop here in passing for the necessary custom-house inspection and clearance. Nearly the entire commerce of Lake Champlain goes through this passage, and the purpose of the proposed breakwater is to shelter tows and vessels while passing through these draw-bridges, and to afford them a sheltered anchorage while detained by heavy weather.

The local interests and business of Rouse's Point itself are insignificant and do not justify any expenditure by the Government, so that the needs of through commerce only should be considered in locating the proposed work.

The harbor to be sheltered is open to the south only, the distance between the inclosing points being 5,100 feet. From these points the open lake extends 5 miles southward to the Isle la Motte, and the waves which are to be encountered are only those which can make in 5 miles sweep.

The sea which can rise in this distance is not large, and can have no effect upon a properly completed structure; 6 feet above level, or 10 feet from trough to crest, is probably larger than the maximum wave. The only forces to be considered in the work are the ice-thrust and the settlement into the soft bottom.

The location of the breakwater which will give the most direct shelter to the harbor is upon the line joining the inclosing points. It is necessary, however, to modify this location by placing the work where the bottom is of the most favorable character, and where the least ice-thrust is to be met. Careful inquiries were made as to the frequency and force of ice-thrusts. They are said to be of rare occurrence, as the entire lake freezes 2 to 3 feet thick, and the ice usually rots in the March sun before any movement takes place, and even then the anchorage of the islands and projecting points generally limits the movement to a few yards. Thrusts do occur, however, at intervals of ten to twenty years, of sufficient force to crowd the solid ice ashore, 20 to 50 feet beyond high-water line, and to wreck weak and rotten structures that are within its reach. The indications are that the force is to be seriously considered, but that it can be provided against.

The breakwater should be located somewhat within the points, rather than upon the line joining them, so that the weight of a large ice-field moving from the open

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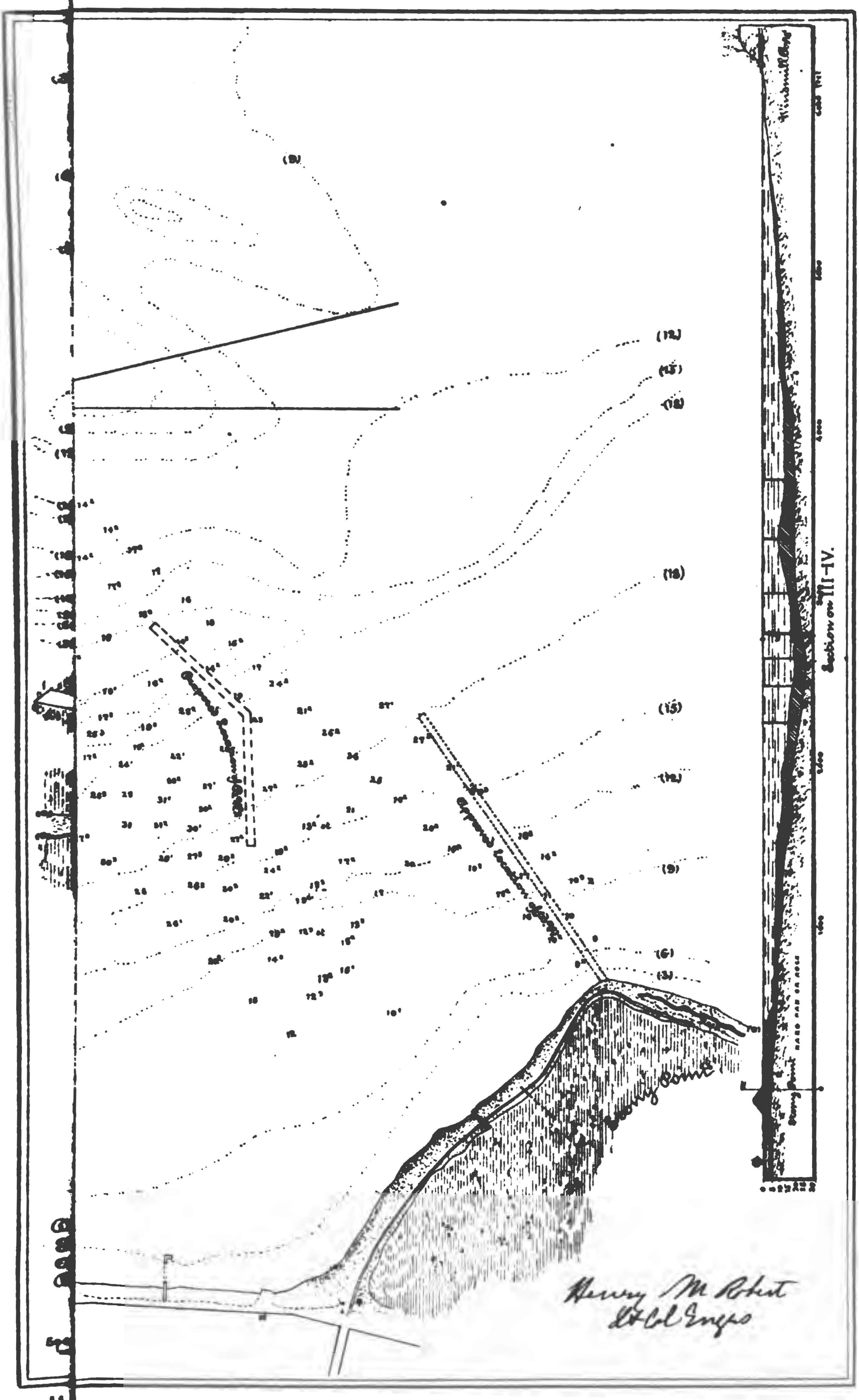
* Map omitted.



Henry M Robert
Lt Col Engrs

H

ke into the harbor would be received and expended upon the points, and the field ius be stopped before reaching the breakwater. The thrust of such portions as ight pass the points, and of smaller fields which might drift between them, would e met by making the breakwater on a broken line with the apex toward the lake, nd also by sloping its exposed face. Lines of soundings and borings located parallel ith the line joining the point show the least depth to the hard bottom exists on the ne 750 feet within the points, or northward from the line joining them.

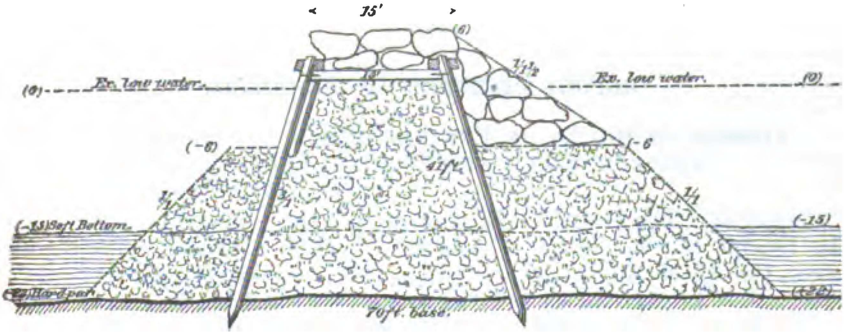
The survey also shows that there are two channels into the harbor, with a middle round having 11 feet depth at extreme low-water level. A detached breakwater ,000 feet long and located midway in the entrance will give the desired shelter, and f the apex at its center is located on this middle ground channels 400 feet wide, with 2 to 14 feet depth at extreme low-water level, will be left at each end. The maxinum draught to be provided for is 10 feet, though the barges and canal-boats draw out 6 feet. The channel now most used is the one nearest Windmill Point, but it will be well to leave both open.

The bottom in the entrance to the harbor consists of a very soft deposit of mud and of clay, having in some places a thin layer of gravel over it. Special care was taken to determine the depth and character of this deposit, and of the underlying hard stratum, which last proved to be hardpan or soft rock throughout.

In addition to borings to the hard substratum, measurements were made upon the proposed line of the breakwater, to determine the limit of the actual sustaining power of the soft material per square foot of area. The results are given in a table upon the map, and show a gradual increase in strength from 203 pounds per square foot of area near the west end of the proposed location to 5,500 pounds per square foot near the east end. These weights will sink a square foot of base 2 feet into the bottom in five minutes. In portions of the entrance this soft deposit was found to be 17 feet thick, but on the proposed line the maximum thickness is 7 feet, and the mean 5 feet. At each point examined the character of the soft material was found to be uniform from top to bottom. It may therefore be assumed that any structure will settle through this soft deposit to the hard substratum. The maximum depth to it on the proposed line is 26 feet, and the mean depth 22 feet.

The absence of any heavy sea and the abundance of stone in the vicinity seem to favor the use of random stone-work for the construction of the breakwater.

Detailed plans and estimates for such a structure are herewith submitted.



ESTIMATE OF COST PER LINEAR FOOT.

40 cubic yards small stone, 12 pounds to 100 pounds each, at 70 cents	$28 00
5 cubic yards blocks of stone, 10 cubic feet or more each, at $3	15 00
1 hard-wood pile, oak, beech, maple, or elm, 30 linear feet, at 15 cents	4 50
Driving one pile (to be placed 1 foot apart in each row)	2 00
60 feet B. M. 12 by 12 inch pine ties (ties to be on alternate piles), 20 feet B. M. 4 by 12 inch pine plank for shutters (on harbor face), at $30	2 40
10 feet B. M. 6 by 10 inch oak stringers, at $50	50
30 pounds iron screw-bolts and straps, at 5 cents	1 50
Contingencies, 25 per cent	13 10
Cost per linear foot	67 00
Estimate of cost per 2,000 linear feet	134,000

It consists of a nucleus formed of two parallel lines of piles converging at their tops tied together and standing in the center of a mass of random stone. This mass consists of stone of the ordinary size used for crib filling, up to a depth of 6 feet below extreme low-water level, to which point they will stand at a slope of 1 on 1, undisturbed by waves or ice. Above this depth the piles will be protected by blocks of stone of 10 or more cubic feet each, placed at random, on the exposed or lake face, at a slope of 1 on 1½, and rising to 6 feet above extreme low-water level, or 1 foot above extreme high-water.

This nucleus of piles will furnish a vertical face on the harbor front where boats can lie alongside, and as the tops of the piles and their timber ties are below the line of no decay (which is 3 feet above extreme low-water level) it does not appear that repairs will be needed. The estimated cost, including 25 per cent. for contingencies, is $67 per linear foot.

A crib-work structure would require a width of at least 40 feet, and would cost [illegible] per linear foot.

It is shown that such a construction as is proposed will stand, by the stability of the railroad structures which cross the harbor. These are less exposed, but are much less solidly built; and are without the proposed stone filling and base. Along these railroad structures it is found necessary, after the heavy ice forms over the lake and harbor, to keep the ice cut from the piles along both sides, and men are employed for this purpose each winter. This operation, however, has no reference to a possible ice-thrust, but is to provide against the effects of the expansion and contraction of the ice with the diurnal variations of temperature, which would cause irregularities in the alignment of the tracks. This action would be of little effect upon the breakwater, and is provided for naturally; as soon as thick ice forms, a crevasse appears in it on the line joining Stony Point and Windmill Point, and this crevasse opens and closes with the changes in temperature.

The proposed manner of construction of the breakwater provides for completing and securing the pile and timber nucleus, in advance of the random stone base and filling; these being depended upon for the permanent stability.

I am, colonel, very respectfully, your obedient servant,

WM. P. JUDSON,
Assistant Engineer.

Lieut. Col. HENRY M. ROBERT,
Corps of Engineers, U. S. A.

REPORT OF BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, January 24, 1885.

GENERAL: The Board of Engineers has the honor to acknowledge the receipt of your letter of January 15, 1885, referring a project by Lieut. Col. H. M. Robert, of January 7, 1885, for a breakwater at Rouse's Point, New York; and also of the accompanying papers.

The Board understands that the question referred to it is as to the site and form of a breakwater and not as to whether a breakwater should be built.

It submits the following report:

From the Report of the Chief of Engineers for 1873, page 404, it appears that a breakwater will be valuable as it protects the passage through the railroad draw-bridge against heavy waves, as it protects the wharves along the western shore of the lake above the draw-bridge; and as it gives a sheltered area within which tows can lie in safety in rough weather.

In the papers transmitted to the Board are statements by Mr. Judson, assistant engineer, that the maximum waves do not exceed 10 feet in height, and by Mr. Gillespie that they break in heavy sheets over the track of the railroad bridge which is 12 feet above mean lake level.

Waves of such size are larger than would have been expected here, and the height of 10 feet is probably not based on accurate observations. But the statements indicate a much heavier sea than could be generated north of Isle la Motte. The bed of the Lake near Stony Point is of hardpan covered by several feet of mud.

To perfectly attain all the objects named above, a breakwater would be sufficient which running from Stony Point to Windmill Point should have in it a moderate opening for the lake flow and for the passage of vessels. But such a breakwater would give more protection than probably will be necessary, at least for many years, and hence involve an unnecessary expense. If the whole of such a breakwater is not built, then the part to be constructed should be that which at the least cost will give the maximum protection.

The Board is of opinion that a breakwater in the lake with both ends distant from the shores, and only 1,600 feet long, will give little protected anchorage, will afford little protection to the passage through the draw; and will give little protection to existing wharves. It believes that with a smaller expenditure of money a breakwater starting from one of the shores can be built which will give as much protection to the draw passage, give more protection to the wharf front, and more protected anchorage area, having at least 6 feet depth at extreme low water, than the breakwater proposed in the project. Such a breakwater, about 2,000 feet long, starting from Stony Point would give for equal length more anchorage protection than one from Windmill Point, as good or better cover for wharves and nearly as good protection for the drawbridge.

The section proposed in the project can, it is believed, be somewhat reduced, subject however to increase should experience in the construction of the earlier part, starting from Stony Point, show such increase to be necessary.

The Board then proposes that a straight breakwater of rubble-stone shall start from Stony Point and run about 2,000 feet in the general direction of the southern point of the 6-foot curve south of Windmill Point and until the 18-foot curve is reached—its precise location to be on the line where the hard bottom lies nearest the water-surface. Should commerce demand greater protection (which probably will not be the case for many years) it could be obtained by a slight extension of this breakwater and by building a corresponding one from Windmill Point.

The Board proposes that the top of the breakwater shall be 1 foot above high water or 8 feet above extreme low water, that the outer face shall have a slope of 1 on 2 to a depth of 6 feet below extreme low water; below that level a slope of 1 on 1, and a slope of 1 on 1 on its inner face.

It is proposed when the breakwater reaches depths sufficient to make the wave attack serious, its outer slope to a depth of 4 feet from the surface of the breakwater, shall be composed of stones weighing from 1 to 3 tons and that from low water up these stones should be arranged as a paving.

The experience gained in the construction of the shore end will indicate whether it is advisable to modify the section in greater depths by either diminishing or increasing it.

It may be found advisable to dredge out the mud on the site of the breakwater rather than to wait for its gradual settlement.

The cost of the breakwater, 2,000 feet long, proposed is estimated at $110,000.

The papers referred to the Board in connection with this subject are herewith returned.

Respectfully submitted.

J. C. DUANE,
Colonel of Engineers,
Bvt. Brig. Gen.
HENRY L. ABBOT,
Lieut. Col. of Engineers,
Bvt. Brig. Gen.
C. B. COMSTOCK,
Lieut. Col. of Engineers,
Bvt. Brig. Gen.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 29, 1885.

SIR: The river and harbor act July 5, 1884, provides as follows:

> Commencing construction of breakwater at Rouse's Point, on Lake Champlain, New York, thirty-five thousand dollars.

With the view to preparing a project for the work Lieut. Col. H. M. Robert, Corps of Engineers, was authorized to make a detailed survey of the locality, and his report thereon, dated the 7th instant, is herewith. He also submitted on same date a project for the proposed structure.

In view of the fact that two examinations of the locality had been previously made under authority of Congress, one in 1872 and the other in 1876, and that the project submitted by Colonel Robert differed from them, it was deemed advisable to submit the whole question to the Board of Engineers for Fortifications and for River and Harbor Improvement for its views and recommendations.

The report of the Board dated January 24, 1885, is respectfully submitted.

I concur in the views of the Board as to the location of the breakwater, and the work being a new one beg to request your approval of the project indicated in its report as far as this location is concerned. The mode of construction should be left for further consideration and action of this office.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. & Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

[First indorsement.]

Approved as recommended by the Chief of Engineers.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT, *February* 3, 1885.

O O 4.

IMPROVEMENT OF SWANTON HARBOR, VERMONT.

The project for this improvement was adopted in 1873, and the undertaking was at that time thought to have been one of doubtful expediency (see report of the officer then in charge in the Annual Report of the Chief of Engineers, 1873, page 396).

Subsequent events have shown that the doubts as to the propriety of this improvement, which were expressed in submitting the original report and project, were well grounded.

The appropriations which have been made from time to time have been expended in the construction of a breakwater. The anticipated docks and wharves that it was designed to protect were never built, however, and what wharf facilities there are at the harbor now, instead of being located where they would receive some protection from the breakwater, are clustered about a small dock three-fourths of a mile distant from it. In consideration of the foregoing facts, and the uncertainty attending the location of such docks and wharves as may be built hereafter, it is recommended that appropriations be withheld from this improvement until a further development of the shipping and commercial interests shall indicate more definitely the direction in which improvements should be made for their protection.

Money statement.

July 1, 1884, amount available	$529 41
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	202 48
July 1, 1885, amount available	326 93
Amount (estimated) required for completion of existing project	169,500 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Swanton, Vt.
Collection district, Vermont.
Nearest light-house, Pointe aux Roches.

Arrivals and departures of vessels during the year ending December 31, 1884.

Description.	Arrivals.		Departures.	
	No.	Tonnage.	No.	Tonnage.
Steamers	212		212	
Sailing vessels	40	4,000	40	
Vessels in tow (barges)	150	18,000	150	

Revenue from customs	$1,711 82
Value of imports	11,985 00

NATURE AND AMOUNT OF IMPORTS DURING THE YEAR ENDING DECEMBER 31, 1884.

	Tons.
Coal	18,000
Iron and iron-ore	2,500
General merchandise	1,500

OO 5.

IMPROVEMENT OF PLATTSBURG HARBOR, NEW YORK.

The original project for the improvement of this harbor was adopted probably at the date of the first appropriation, in 1836, and proposed the construction of a breakwater about 1,000 feet east of the steamboat docks.

There were 1,250 linear feet of breakwater constructed between 1836 and 1875, at which latter date the last modification of the project was completed. This modification, made in 1870, provided for an extension of the former structure to the southeast, the dredging of some shoal areas within the breakwater, and the protection of a portion of the adjacent beach by a revetment.

Since 1875 operations have been confined to repairs and the dredging of limited areas between the breakwater and the steamboat docks.

During the season of 1884 there were 3,022 cubic yards of material removed from shoal places near the steamboat docks, in order to afford sufficient depth for the steamers frequenting the harbor. The work done was to the extent of the available funds. An additional amount of dredging might be done, however, with advantage to the harbor.

The act of Congress approved July 5, 1884, provided for a survey and examination of the mouth of the Saranac River at Plattsburg. This survey was made in December, 1884, and the maps and reports in relation thereto were transmitted under date of December 26, 1884. For the purpose of affording additional information this survey was extended so as to include the area near the steamboat docks.

As additional funds become available for this harbor it is expected to apply them in dredging of shoal areas within the breakwater, and in making repairs to it as required.

The commercial statistics for this harbor during the year ending December 31, 1884, could not be furnished by the collector of customs, owing, as he informs me, to a reduction in his clerical force by sickness, consequently the statement of a year ago is submitted, being the best that can be done under the circumstances, and probably approximates the same as the statement for this year would have been.

Revenue from customs	$6,196 79
Value of imports	29,961 22

Money statement.

July 1, 1884, amount available	$1,278 85
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,190 79
July 1, 1885, amount available	88 06
Amount (estimated) required for completion of existing project	12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887.	5,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Arrivals and departures of vessels during the year ending December 31, 1883.

Description.	Arrivals.		Departures.	
	No.	Tonnage.	No.	Tonnage.
Steamers	750	419,168	750	419,168
Sailing vessels	50	4,127	51	4,210

O O 6.

IMPROVEMENT OF BURLINGTON HARBOR, VERMONT.

The first project for the improvement of this harbor was probably adopted about 1836. Modifications of the original project have been made from time to time so as to afford adequate protection to the increased commercial and shipping interests of the harbor. In 1874 a modification was proposed, whereby an extension 2,000 linear feet northward was effected (see Report of Chief of Engineers, 1874, page 274). Again in 1884 a further extension of the breakwater to the south was proposed by the officer then in charge, and the new work in progress during the past season has been in conformity with this last recommendation. In May, 1884, about 1,100 linear feet of the oldest portion of the breakwater was much injured by a gale. The officer in charge submitted a report thereon May 15, and the repairs made during the working season of 1884 were applied to this injured portion of the old structure.

The appropriation act approved July 5, 1884, contained two items for Burlington Harbor, viz:

Improving harbor at Burlington, Vt., Continuing improvement	$25,000
For repairs	25,000

For the purpose of continuing the improvement a contract was entered into with Luther Whitney, dated August 29, 1884, for 200 linear feet of extension to the breakwater southward. The repairs were made by purchase of materials from principal dealers, after inviting proposals in a circular letter dated July 28, 1884, and by hired labor.

During the working season of 1884 the work under contract progressed to the extent of placing four cribs 50 feet long, 30 feet wide, and 28 feet high, in accordance with the contract. The cribs rested on a foundation of random stone 6 to 8 feet high and about 45 feet wide on top.

Some work was done during the winter (February and March, 1885), in order to have the timber portion somewhat above extreme low water, so that operations might be resumed in the spring without waiting for the water to go down after the usual rise at that season of the year.

It was found that the contract, in failing to provide for an irregular angle-crib to fill a space between the old and new work, could not well be completed until a modification was made in it so as to provide for this work, in order that the proper bonding might be effected. But for this necessary modification of the contract, which now awaits the approval of the Secretary of War (having been transmitted under date of June 23, 1885), the original contract would have been completed in accordance with its terms by the end of the fiscal year. A day or two will be sufficient time in which to complete all the work comprehended in the original. This small portion must necessarily await action on the modified contract, however, so that all may be finished in a workmanlike manner.

The repairs to the breakwater covered 1,175 linear feet, being the portion injured by the gale in May, 1884. The work consisted in building a parapet superstructure 10 feet wide, and so as to be flush with the substructure on the lake face. About half this parapet was carried to 10 feet above low water, and the rest to 8 feet above the same level. The stone required for filling, in excess of that taken from the old work, was purchased in open market. The amount expended in the repairs during the season of 1884 was $16,578.87.

There are portions of the old work in addition to that which was in jured and repaired, which have become so badly decayed above water as to require repairs before they are subjected to the gales of another winter season. It is expected, therefore, to resume repair-work soon along the older portions of the breakwater, partly in the same manner as was done last season, and partly by the renewing of old and rotten timbers and filling spaces with stone as required.

As additional funds become available for this work it is expected they will be applied in further extension of the breakwater, so as to keep pace with the growth of the commerce and the extension of the line of docks and wharves, and for general repairs of the older portions of the existing structure.

The miscellaneous expenses during the year amounted to $2,745.12, of which amount $912.52 were incurred under my charge, mostly for necessary articles in connection with starting of this new office.

Money statement.

July 1, 1884, amount available		383 26
Amount appropriated by act approved July 5, 1884		50,000 00
		50,383 26
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$37,120 99	
July 1, 1885, outstanding liabilities	1,960 27	
		39,081 26
July 1, 1885, amount available		11,302 00
Amount (estimated) required for completion of existing project		203,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		50,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Name of harbor, Burlington, Vermont.
Collection district, Vermont.
Nearest light-house, Juniper Island.

Arrivals and departures of vessels during the year ending December 31, 1884.

Description.	Arrivals.	Departures.
Steamers	1,143	1,143
Sailing vessels	500	500
Vessels in tow (barges)	783	783

Revenue from customs	$118,114 21
Value of imports	931,597 00

NATURE AND AMOUNT OF IMPORTS DURING THE YEAR ENDING DECEMBER 31, 1884.

Coal	tons	71,824
Lumber	feet, B. M.	70,257,699
General merchandise	tons	11,500
Iron	do	3,430

The above information was obtained through the kindness of the collector of customs.

O O 7.

IMPROVEMENT OF OTTER CREEK, VERMONT.

The project for this improvement was adopted in 1872, and, as modified in 1882 and 1884, proposes the formation of a channel from Vergennes, Vt., to Lake Champlain, of a navigable width, and to afford a least depth of 8 feet. (See Reports of Chief of Engineers, 1872, page 273; 1882, page 712; and 1884. page 2159.)

During the fiscal year ending June 30, 1885, operations as carried on consisted in the improvement of Bull Brook Bend and its immediate vicinity by dredging.

Operations were conducted in accordance with the project submitted by the officer in charge, dated July 7, 1884; and, under an agreement made with Luther Whitney, at the rate of 25 cents per cubic yard, scow measurement, there were 9,237 cubic yards of material removed from the channel at the bend, and 2,536 cubic yards from a shoal place about 600 feet above, which resulted in securing a good channel 75 feet wide and 8 feet deep at low water, through what had previously been the most serious obstruction on Otter Creek.

In order to escape a rock reef on the north side of the creek, it was necessary to encroach from 5 to 25 feet upon the natural bank on the south side. The local authorities and other interested parties at Vergennes arranged with the owners of the land so as to secure the necessary permission for this work to be done.

Besides the operations proposed at Steamboat Landing, as provided for in modified project of 1882 (see Report of Chief of Engineers, 1882, page 712), the channels at Sharkie's Bend and Crittenden's Bend require widening and deepening, so as to remove the present difficulties which tows have in passing these points; and the channel at the mouth of the creek should be improved.

No commercial statistics could be obtained from the collector of customs under the above head, although he was repeatedly requested to furnish a statement on the subject.

Money statement.

July 1, 1884, amount available	$3,851 92
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,203 58
July 1, 1885, amount available	648 34
Amount (estimated) required for completion of existing project	39,748 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

O O 8.

IMPROVEMENT OF TICONDEROGA RIVER, NEW YORK.

The project for this improvement was adopted in 1881, its object being to afford a channel of navigable width and a least depth of 8 feet at low water between the falls at Ticonderoga Village and Lake Champlain, a distance of about 2 miles (see Report of Chief of Engineers, 1881, page 726). The estimated cost of the improvement was $42,516, of which amount $10,000 have been appropriated, and all available funds were practically exhausted by the close of the fiscal year ending June 30, 1884.

There have been no operations during the fiscal year ending June 30, 1885.

A channel now exists from Lake Champlain to the head of navigation which has a least width of 60 feet, except the upper 2,000 feet, which is only 30 feet wide, and affords a least depth of 6 feet throughout.

To complete the improvement in accordance with the project the channel should be widened in its upper reach to 60 feet and should be generally deepened.

The principal industry subserved by this improvement is the manufacture of pulp and paper from wood fiber, which requires the annual transportation of about 2,000 tons of coal and about 10,000 cords of wood.

Money statement.

Amount (estimated) required for completion of existing project............	$32,516 00
Amount that can be profitably expended in fiscal year ending June 30, 1887.	10,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

O O 9.

PRELIMINARY EXAMINATION OF WHITEHALL HARBOR, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., October 15, 1884.

SIR: In compliance with your instructions, dated July 31, 1884, I have the honor to submit the following report of the result of an examination made by me, on the 6th and 7th instant, of Whitehall Harbor, New York.

Whitehall, containing a population of about 4,000, is at the head of navigation on Lake Champlain, and at the northern terminus of the Champlain Canal, which connects Lake Champlain with the Hudson River at Troy.

The entire commerce of the place is carried on in canal-boats. To the south the canal is used, and to the north the lake. In the latter case the canal-boats are placed two or three abreast, and then towed by large tugs to their destination on Lake Champlain, or to Saint John's on the Richelieu River, at the head of the Chambly Canal, in Canada. The tow from Whitehall to Saint John's is about 150 miles. After reaching Saint John's the canal-boats are taken down the Chambly Canal and Richelieu River to the Saint Lawrence River.

Thus it will be seen that Whitehall is merely a station on the water route connecting the Hudson and Saint Lawrence rivers, but a station where is made up the tows for the north and where is broken up the tows coming south. By examining the statistics in statement B,[*] appended hereto, it will be seen that of all the commerce entered at Rouse's Point and cleared for Whitehall and points south ($3,662,144.50), only 13 per cent., or $477,152.50, is cleared for Whitehall itself.

This through commerce carried in tows of canal-boats averages daily each way one tow of thirteen canal-boats, carrying 150 tons each, or about 4,000 tons daily in the season of navigation. This gives an aggregate of about 6,700 canal-boats, carrying 1,000,000 tons each season, that pass through the Narrows of Lake Champlain. Ten cents per ton on the commerce of one year would give a sum ample to improve the entire Narrows from the canal locks at Whitehall to Benson's Landng, a distance of about 14 miles. In my judgment this should all be treated as one improvement, and not subdivided into "Whitehall Harbor," "Four Channels," &c. While examining Whitehall Harbor I found that the improvement desired consisted in dredging the channel and basin from the Canal Lock to the Elbow 1 mile below, and also a little work at the Elbow. All this improvement is worthy to be made, and yet it is rather stretching the "harbor" to make it extend so far. If the survey is ordered I would propose to include the Elbow, as the additional expense would be trifling.

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[*] Omitted; printed in House Ex. Doc. No. 138, Forty-eighth Congress, second session.

Should Congress make an appropriation for this improvement, I would recommend that the title be "Improving the Narrows of Lake Champlain from Benson Landing, Vermont, to Whitehall, N. Y." This would cover all the difficulties that I am acquainted with between the northern end of the Champlain Canal and the wide portion of Lake Champlain, including the Four Channels, of which a preliminary examination has been made.

It is much better to treat them all as one channel, for the commerce heretofore spoken of is equally interested in the entire channel, and it would be troublesome to have appropriations for each separate point, some of which might not require $500. This would also render it unnecessary to make Whitehall Harbor so elastic as to be stretched out of sight of the village.

I consider the improvement worthy to be made, and would estimate the cost of the survey, maps, &c., at $200.

Appended hereto are three statements of commercial statistics, marked A, B,* and C.*

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

A.—*Statement showing the number of vessels passing through the Whitehall Narrows and into and out of Whitehall Harbor during the season of navigation in 1882 and 1883.*

[Furnished by Mr. Robert H. Cook, secretary and treasurer New York and Lake Champlain Transportation Company.]

SEASON OF 1882.

Whole number of tows	557
Average number of boats in tow	13
Total number of boats	7,338

Average tonnage of each vessel, 150; total tonnage passing through the Narrows, 1,108,200.

SEASON OF 1883.

Whole number of tows	507
Average number of boats in tow	13
Total number of boats	6,482

Average tonnage of each vessel, 150; total tonnage passing through the Narrows, 972,300.

In addition to above there was towed as above 300,000 cubic feet of square and round timber, 15,000 tons.

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*Omitted; printed in House Ex. Doc. No. 138, Forty-eighth Congress, second session.

SURVEY OF WHITEHALL HARBOR, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., January 10, 1885.

SIR: I have the honor to submit the following report on the survey of Whitehall Harbor, New York, just completed under my direction by Assistant Engineer William P. Judson.

The report on the preliminary examination of this locality made by me personally was submitted under date of October 15, 1884.

The survey shows that to properly improve Whitehall Harbor from the canal locks to just below the Elbow, a distance of about 1 mile, it will be necessary to remove about 80,000 cubic yards of mud and about 600 cubic yards of bed rock, at an estimated cost of $30,000.

This would give a good channel 12 feet deep at extreme low water and about 150 feet wide, and would dredge out the basin to within 25 feet of the docks to the same depth.

Assistant Engineer Judson's report and map of the survey are forwarded herewith.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. WILLIAM P. JUDSON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., January 10, 1885.

COLONEL: I have the honor to submit herewith the results of a survey of the head of Lake Champlain, including Whitehall Harbor, New York, and extending 1½ miles northward around the Elbow, at Putnam's Rock.

The survey was made December 25–27, 1884, and the map is herewith submitted.

The plane to which the soundings and borings are referred is extreme low-water level, as indicated by the zero of the gauges at Fort Montgomery and Burlington. This plane is 8.75 feet above the miter-sill of the first or lower lock of the canal at Whitehall.

The obstructions to navigation which exist within the area covered by the survey are:

First. A ledge of rock in mid-channel at the Elbow, having a minimum depth of 7 feet at extreme low water.

Second. The narrow space at the Elbow in which to swing the tows around the short turn of 290 degrees which must there be made in a distance of 600 feet.

Third. The general shoal and narrow character of the channel from the Elbow, for 2,600 feet, to a point 2,000 feet below the first lock of the canal at the head of Whitehall harbor. This portion of the channel has a governing depth of 11 feet, with a least width of 40 feet and a greatest width of 80 feet, between the 10-foot curves.

Fourth. Shoals in the basin of Whitehall Harbor *and in the approach to it.*

The rock which forms the first obstruction is a mass of trap rock, whose base at 12 feet depth is about 130 feet long by 60 feet wide, with the longest axis lying across the channel.

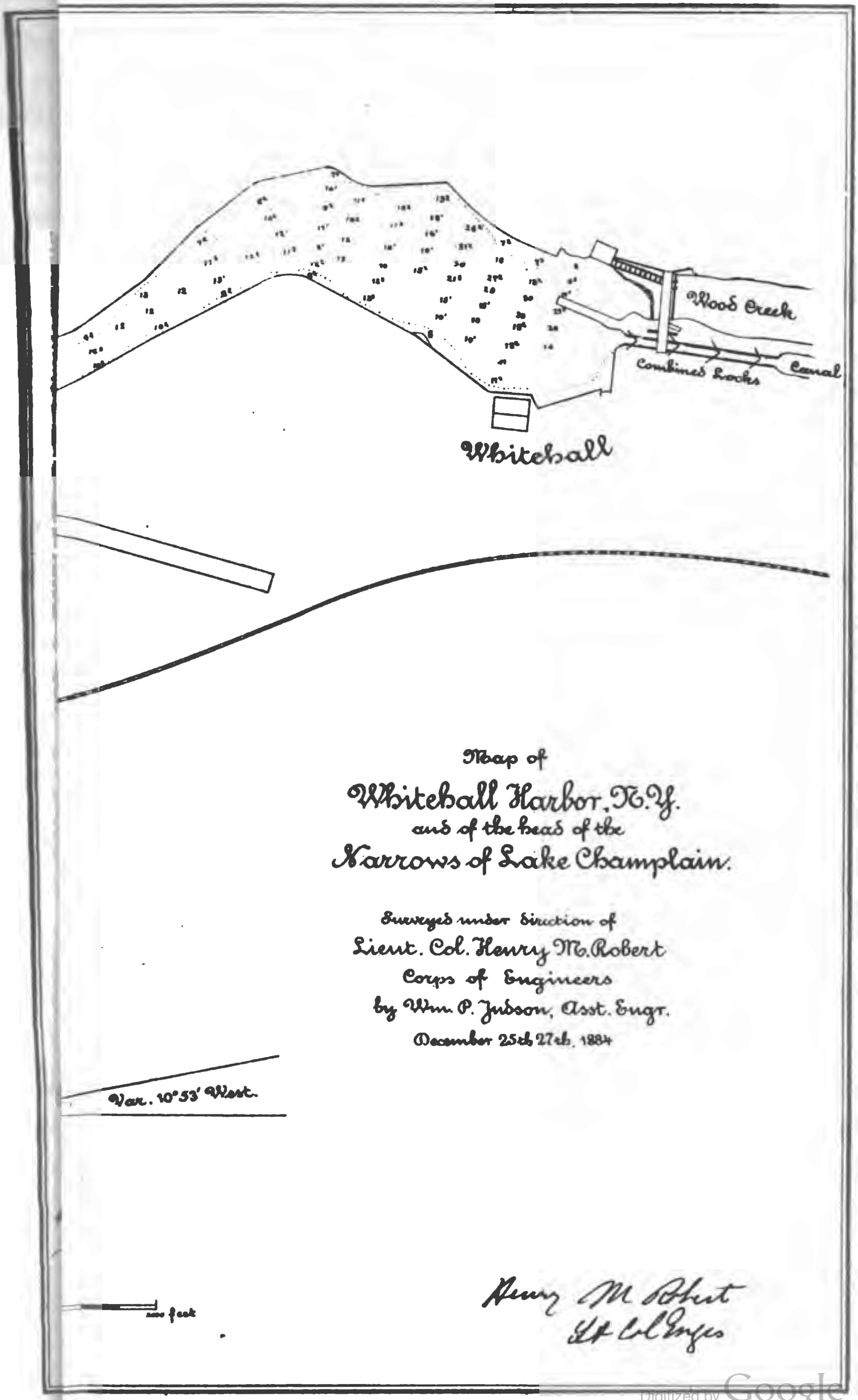
The mean depth over the mass is 9 feet, but sharp pinnacles rise from this plane to 7 feet depth.

These pinnacles lie in mid-channel, and are much feared by the steamers, which have been repeatedly damaged by them.

The removal of this rock to 12 feet depth (allowing 1 foot below that depth for irregularities) requires the excavation of about 600 cubic yards, in position, the cost of which removal is estimated at $5 per cubic yard.

The work can be best done from the ice, when the most favorable points for blasts can be exactly located and hindrance by passing tows can be avoided.

A considerable part of the broken rock would probably be thrown by the blasts into the closely adjacent deep water, and the remainder can be readily removed by a dredge.



Map of

Whitehall Harbor, N.Y.

and of the head of the

Narrows of Lake Champlain.

Surveyed under direction of

Lieut. Col. Henry M. Robert

Corps of Engineers

by Wm. P. Judson, Asst. Engr.

December 25th 27th. 1884

Henry M Robert
Lt Col Engrs

The cost is estimated at 600 cubic yards rock excavation, at $5=$3,000.

To widen the channel at the turn of the Elbow, the channel should be deepened to 12 feet by excavating a width of 75 feet next the shore, and also by excavating the shoal opposite to the Elbow, and thus widening the channel 100 feet on that side.

This will give 300 feet width at the turn, and will require the removal of 9,000 cubic yards, scow measurement, of soft mud and clay.

The cost of this removal is estimated at 9,000 cubic yards mud excavation, at 30 cents=$2,700.

From the Elbow, for 2,600 feet towards the basin of Whitehall Habror, the channel is shoal and narrow. It has a governing depth of 11 feet, with a least width of 40 feet, and a greatest width of 80 feet between 10-foot curves.

To deepen this to 12 feet for a width of 150 feet will require the removal of 60,000 cubic yards of soft mud and clay, at an estimated cost of 30 cents per cubic yard, scow measurement.

The cost is estimated at: 60,000 cubic yards of mud excavation, at 30 cents, $18,000.

From this point to the canal at the head of Whitehall Harbor, a distance of 2,000 feet, there is a governing depth in the channel of 12 feet, with a least width between the 10-foot curves of 80 feet.

There is shoal water, however, along both sides of the channel and at various points in the harbor. For the deepening of this to 12 feet it is estimated that 10,000 cubic yards of excavation will be needed.

The cost is estimated at: 10,000 cubic yards of mud excavation, at 30 cents, $3,000.

To determine the character of the material to be removed, about five hundred borings were made, all of which showed soft mud to 14 feet below zero within the limits of the channel above proposed.

Stiff clay, at 6 feet depth, was found at only one place, which was at the side of the channel 3,200 feet from the head of Whitehall Harbor.

The material to be dredged is soft mud of the most favorable character for removal. The cost is estimated at 30 cents per yard, to provide for the expense of towing 4 miles down the lake to South Bay, in the deep water of which the dredged material can be dumped.

The actual draught of steamer to be provided for is 10½ feet, for which 12 feet depth is ample.

SUMMARY.

The total cost of improving this portion of the Narrows of Lake Champlain and Whitehall Harbor may be summarized as follows:

Removal of rock at Elbow: 600 cubic yards, at $5	$3,000
Widening channel at Elbow (9,000 cubic yards); widening and deepening 2,600 linear feet of channel to 150 feet width and 12 feet depth (60,000 cubic yards); widening channel and removing shoals in Whitehall Harbor (10,000 cubic yards). Total mud excavation, 79,000 cubic yards, at 30 cents	23,700
Contingencies and superintendence	3,300
Sum total	30,000

It seems probable that the deepening here estimated for will be of permanent effect. The channel was naturally a deep one. It was shoaled in years past by the wearing down of the banks by the "wash" of the side-wheel steamers which formerly came up to Whitehall.

These boats no longer come up the Narrows, but now stop at the end of the broad lake at Ticonderoga.

The only steamers which now pass regularly are screw steamers, which tow fleets of canal-boats, and which make little or no "wash."

I am, colonel, very respectfully, your obedient servant,

WILLIAM P. JUDSON,
Assistant Engineer.

Lieut. Col. H. M. ROBERT,
Corps of Engineers, U. S. A.

O O 10.

PRELIMINARY EXAMINATION OF LAKE CHAMPLAIN AT FOUR CHANNELS, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., October 15, 1884.

SIR: In compliance with your instructions, dated July 31, 1884, I have the honor to submit the following report of the result of an examination made by me, on the 7th instant, of Lake Champlain, at Four Channels, New York.

The upper end of Four Channels is about 12 miles north of Whitehall, and Benson Landing, Vt., at the lower end of Kinyon's Bay, is 2 miles farther north. Between these two points lie the difficulties which it is desired to remove. Of the four channels only the eastern one can be now used by a tow, and it is too narrow for tows to pass one another, and yet tows cannot stop, like single boats, to let another one pass, without getting all tangled up. A single long tow is endangered by being obliged to pass so near the rocky shore of Cedar Mountain, which forms the right bank. A sufficiently wide channel for two tows to pass one another should be provided here by dredging.

At the lower end of Four Channels begins Kinyon's Bay, which is very shallow. The Coast Survey chart shows only 8½ feet at the shallowest part of the channel, while the tugs draw from 9½ to 10 feet. I understand that there is a very narrow channel, kept open by the wheels of the tugs, but it is difficult to keep. The tug I crossed the bay in struck twice, and the pilot told me that the previous day it had taken him one hour to get his tow across this bay, a distance of 1 mile. A suitable channel should be dredged here.

The commercial importance of this improvement is discussed in the preliminary report made this day on Whitehall Harbor. The daily commerce passing though the Narrows of Lake Champlain, and affected by this improvement, is 4,000 tons, or 1,000,000 tons annually. As stated in the report on Whitehall, both of these improvements should be included in one, under the title of "Improving Lake Champlain Narrows from Benson Landing, Vt., to Whitehall, N. Y."

While the examination ordered is called "Lake Champlain at Four Channels, New York," and might mean only the Four Channels, I have interpreted it to include the lake in that vicinity. But if an appropriation is made, its intended application should be clearly defined.

I think the improvement is worthy to be made, and would estimate the survey, maps, &c., to cost $200.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF LAKE CHAMPLAIN AT FOUR CHANNELS, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., January 28, 1885.

SIR: I have the honor to submit the following report on the survey of Lake Champlain at Four Channels, New York, just completed under my direction by Assistant Engineer William P. Judson.

The report on the preliminary examination of this locality, made by me personally, was submitted under date of October 15, 1884.

The survey was extended beyond the exact limits of Four Channels, since my preliminary examination above referred to established the fact that across Kinyon's Bay, which is adjacent to and just below the foot of Four Channels, a shoal occurred carrying only 9 feet at low water.

The improvement of the channel across Kinyon's Bay is fully as necessary as the improvement at Four Channels.

Although the survey ordered is called "Lake Champlain at Four Channels, New York," I have construed it, as stated in my preliminary report, to include the lake in its immediate vicinity.

The survey shows that to properly improve that part of Lake Champlain between the head of Four Channels and deep water in Kinyon's Bay, a distance of about 2 miles, it will be necessary to remove about 170,000 cubic yards of mud, together with the probable closure, at a small expense, of the "Cross Channel."

The estimated cost of this work is $50,000. It seems highly probable that the channel across Kinyon's Bay can be improved upon the lines indicated by Assistant Engineer Judson without changing the present site of Beacon XV. The improvement proposed would give a channel 12 feet deep at extreme low water, and about 200 feet wide in the portion improved.

Assistant Engineer Judson's report and map* of the survey are forwarded herewith.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. WILLIAM P. JUDSON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., January 27, 1885.

COLONEL: I have the honor to submit the following report upon the survey of Lake Champlain at and near Four Channels, New York.

The survey was made between December 29, 1884, and January 5, 1885, and the map of it, which is herewith submitted, shows that portion of the Narrows of Lake Champlain lying between the head of Four Channels on the south and Benson Landing, at the foot of Kinyon's Bay, on the north, a distance of 2¼ miles.

The average width is one-half mile.

The obstructions to navigation in this portion of the lake occur within these limits, there being a clear channel above and below.

The passage known as Four Channels lies between the head of Cedar Mountain, on the Vermont shore, and Pulpit Point, on the New York shore.

The width of the Narrows at this point is 1,000 feet.

This space is divided into three channels by two parallel lines of narrow mud banks, or low islands, whose tops are covered by rushes, and are at about 2 feet above extreme low-water level.

These channels may be described as the West Channel, the Center Channel, and the Cedar Mountain or East Channel. There is also the Cross Channel, which latter is a cut-off, connecting the Center Channel with the Cedar Mountain Channel.

Of these the West Channel is closed by gradual deposit, and by the upheaval of the bottom, caused by the subsidence of the railroad embankment which skirts the west shore. This upheaval has also formed three islands of 200 by 50 feet each, which appear on the map.

This channel need not be considered.

The Center Channel is 100 to 150 feet wide between 9-foot curves with a governing depth of 11½ to 12 feet at extreme low-water level.

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* Omitted.

It is not much used, apparently because the lower 1,000 feet of its course lies along the west shore, and boatmen fear damage from projecting rocky points and from random blocks of granite and other obstructions which the railroad company has placed along its embankments, to stop the wash, and to check the subsidence of the tracks.

The railroad here follows the shore line closely, cutting through the rocky points and filling across the bays.

These fills have constantly settled since their construction, many years ago, and vast quantities of material have been put into them. Old canal-boats, trees, stumps, and brush, as well as earth and random stone, have been freely used.

To avoid these, boatmen shun the west shore.

The portion of the shore along which the Center Channel runs lies from southwest to northeast, so that passing tows would be drifted onto it by the current, and by a southerly or an easterly wind.

For this reason, and because it would require nearly as much excavation as the Cedar Mountain Channel, the improvement of this channel is not advised.

The Cedar Mountain Channel (excepting at its head, above the confluence of the Cross Channel, or cut-off) is 120 feet to 150 feet wide between the 9-foot curves, with a governing depth of 13 feet.

In the portion excepted, for a length of 1,500 feet it is 80 to 100 feet wide, with a governing depth of 13 feet.

This is the channel whose improvement is recommended.

It is now the most used, and if the portion above referred to is widened to 200 feet it will meet all requirements of commerce.

If excavated it will be subject to encroachment upon one side only, the east side being the vertical rock face of Cedar Mountain, close to which the channel runs for 6,000 feet, to the head of Kinyon's Bay.

It is evident that the comparatively narrow head of this channel is due to the deflection of current through the Cross Channel.

To maintain the increased area of cross-section, as proposed, the Cross Channel should be closed.

This can be done at a minimum of cost by depositing in it a portion of the dredged material, and thus joining the two mud banks or islands which the Cross Channel now separates.

The space is but 100 feet wide, and can be closed by 7,500 cubic yards of material.

The closure will be permanent if placed midway between the ends of the Cross Channel, and also if covered on the upper side by an apron of brush mattress secured by piles.

This apron would be a simple and inexpensive construction of fascines and brush, 120 feet long by 12 feet wide by 2½ feet thick.

A similar mattress was built by me at Wilson Harbor in 1882, and cost $1.20 per square yard of surface (see page 2438, Report Chief of Engineers, 1882).

Its foot would be ballasted by a line of stone, and its top secured to ten piles placed on its down-stream side. These piles can be driven at small cost by a water-jet.

The cost of forming the bank of dredged material behind this apron would be equal to the services of four men for 12 days to unload scows.

ESTIMATE.

160 square yards brush mattress, at $1.20	$192
10 piles, at $2 each	20
Driving, at $2 each	20
50 yards stone, at $1 per yard	50
48 days' labor, at $1.50 per day	72
Superintendence and contingencies	146
Total	500

For the present improvement of the Cedar Mountain Channel, and to give relief until the whole of the 1,500 linear feet shall be improved, 550 linear feet of its upper end should first be widened.

This will require the excavation of 30,000 cubic yards of material. To widen the remainder of the proposed 1,500 feet cut will require the excavation of 35,000 cubic yards additional.

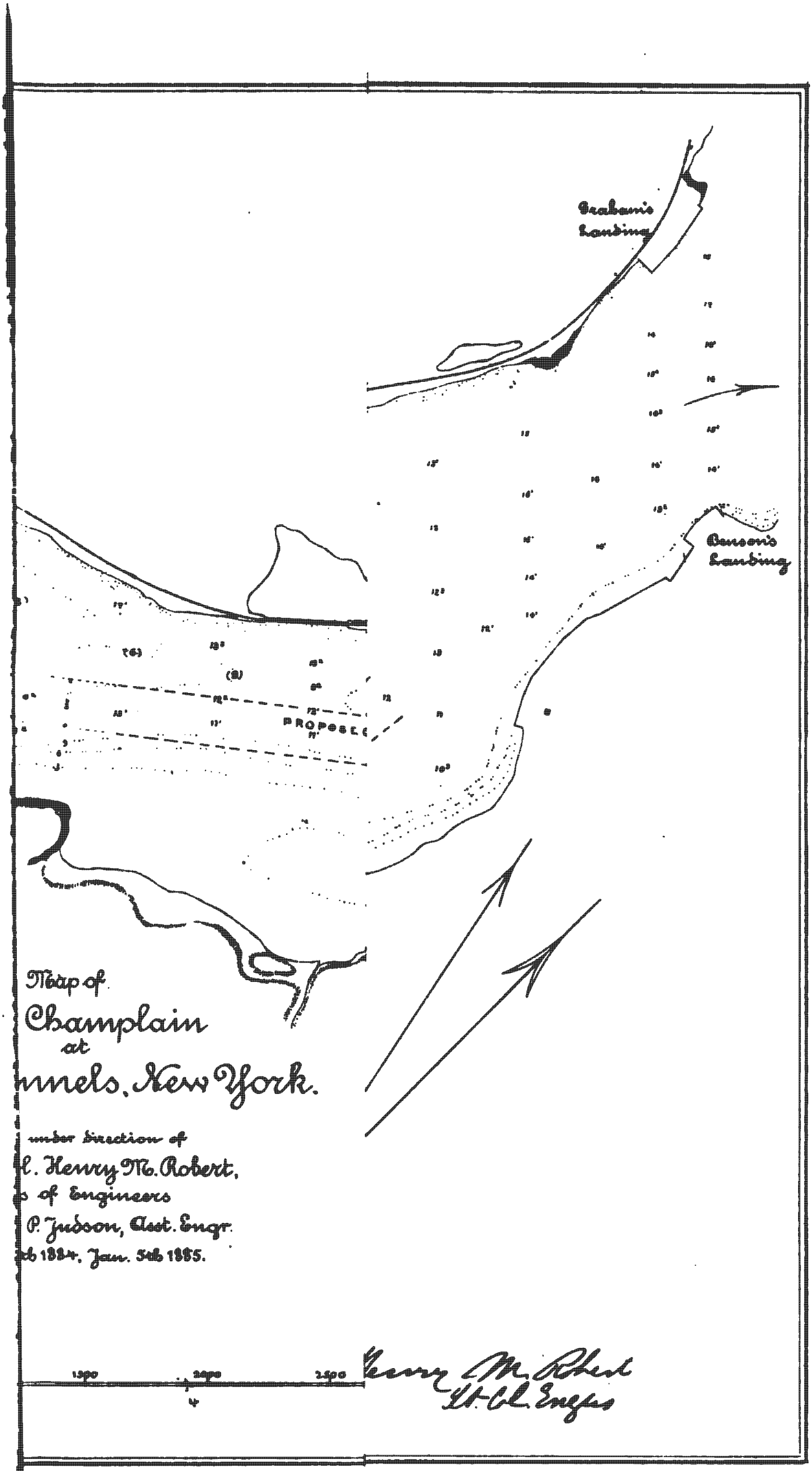
All the material is soft mud.

The cut estimated for is 200 feet wide at bottom, with side slopes of one on four, with 12 feet depth at extreme low-water level.

It has been further suggested that a boom should be placed along the rocks of Cedar Mountain to prevent boats from crowding onto them, several cases of damage having thus occurred.

If the channel is widened this boom will not be necessary.

Three-fourths of a mile further northward, at the foot of Cedar Mountain, the Narrows widen into Kinyon's Bay.


Graham's Landing
Benson's Landing
PROPOSED
Map of
Champlain
at
nnels, New York.
under Direction of
l. Henry M. Robert,
s of Engineers
P. Judson, Asst. Engr.
b 1884, Jan. 5th 1885.
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Lt. Col. Engrs

The several channels before described here unite in one shallow channel across the bay, the entire area of which is shoal.

This channel has a governing depth of 9½ feet, with a width of 100 to 200 feet between the 9-foot curves.

The actual maximum draft of the passing tow-boats being 11 feet, the need for deepening this channel is urgent.

The present channel, as above described, is defined by a beacon at each end—Beacon No. XV at the head and Beacon No. XVI at the foot. The line joining these beacons is exactly the center of the existing narrow channel.

The proposed cut should begin at 700 feet north from Beacon XV, and extend 5,100 feet northward. The cut should be 12 feet deep at extreme low-water level, with a width at bottom of 200 feet.

The side slopes are estimated at one on four, because of the extremely soft character of all the material.

Such a channel located on the line now marked by the beacons would require the excavation of 125,000 cubic yards of material.

By moving the upper end of the range 75 feet westward, this amount would be reduced to 105,000 cubic yards.

This saving would justify moving Beacon XV to the westward 75 feet, in case such removal were considered necessary.

It is not probable that this channel will be permanent, though it is the only one which can be made across Kinyon's Bay.

The effective scour of the spring current will be slight in the wide water of the bay, and the soft material of the shoals on each side of the cut may be expected to encroach on the proposed excavation.

Examination of the curves shows that the wash from the banks and shoals above is here depositing, and is gradually extending the islands and mud banks of "The Marsh," which at present terminate at the foot of Cedar Mountain, Beacon XV marking their extreme northern limit.

It would be impracticable to deepen or maintain this channel by any construction to confine the current.

Such construction to be of effect must reach to high-water level; it must be massive, to resist the thrust and impact of heavy ice; its efficiency would be doubtful; and its cost and maintenance, capitalized, would exceed the expense of repeated dredging.

The channel here described carries the improvement to Benson Landing, northward from which point there is a deep and clear passage-way.

The needs of commerce will be best supplied by (1) making a single deep cut along the center of the proposed Kinyon's Bay Channel, and dumping the material in the deep water on the east shore, 2 miles north of Benson Landing; (2) widening the head of Cedar Mountain Channel and using parts of the material to close the Cross Channel.

Finally, alternating operations on the continuance of those two works until both are completed.

The only interests to be considered in the improvements are those of passing commerce. There are no local concerns of any kind to be affected by either work.

The depths referred to here and upon the maps are below the plane of extreme low-water level, as shown by the zero of the Fort Montgomery and Burlington gauges.

This plane is 8.75 feet above the top of the miter-sill of the first lock at Whitehall.

High-water level, as shown upon the face of rock at Cedar Mountain, is 5.5 feet above zero.

Extreme high-water level is one foot higher, or 6.5 feet above zero.

Mean-water level during the months of May to December, inclusive, for the twelve years from 1870 to 1882, is 1.6 feet above zero.

The survey was made on the ice, and each of the fourteen hundred soundings shown on the map was accurately located.

At each alternate sounding a boring was made to 13½ feet depth. Soft mud was found everywhere, except in some cases, at the first sounding next the shores, when pieces of fallen rock were struck.

In the quantities of excavation which are estimated for, the usual addition of 20 per centum to the measurement in position has been made, to reduce to scow measurement.

The estimated work is summarized as follows:

	Cubic yards.
Widening the head of Cedar Mountain Channel to 200 feet, for 550 linear feet.	30,000
Widening 950 linear feet additional of Cedar Mountain Channel to 200 feet....	35,000
Widening and deepening channel across Kinyon's Bay, 5,100 linear feet, 200 feet wide..........	105,000
Total scow measurement..........	170,000

At 25 cents per yard	$42,500
Brush mattress and piles to cover material deposited to close Cross Channel	500
Moving Beacon XV	1,000
Contingencies	6,000
Total	50,000

The proposed depth throughout is 12 feet at extreme low-water level.

No statement of the passing commerce to be benefited by the proposed work was obtained.

As, however, the entire through commerce of Lake Champlain and the Whitehall Canal must pass here, its annual amount is large, and justifies the proposed improvement.

I am, colonel, very respectfully, your obedient servant,

WM. P. JUDSON,
Assistant Engineer.

Lieut. Col. HENRY M. ROBERT,
Corps of Engineers, U. S. A.

O O 11.

PRELIMINARY EXAMINATION OF MOUTH OF THE SARANAC RIVER AT PLATTSBURG, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., September 26, 1884.

SIR: I have the honor to report that, in compliance with the instructions of the Chief of Engineers, dated July 31, 1884, I made a personal examination of the mouth of the Saranac River at Plattsburg, N. Y., on the 19th instant, and also consulted with the various parties interested in the improvement. What they desire is increased harbor facilities, especially in connection with the Delaware and Hudson Canal Company Railroad depot, so as to make Plattsburg a lumber-distributing port. After carefully looking over the ground, it appeared to me that, instead of dredging out the entire mouth of the river, it would be better to excavate a channel on the north side, about 250 feet wide, from the 10-foot curve in the bay to the inner shore line, a distance of about 2,200 feet, to a depth of about 9 feet, provided no rock has to be dredged. Making a rough estimate from the Lake Survey and from observation, this plan would require the excavation of about 160,000 cubic yards, at an expense of about $40,000. The railroad company would dock the south side of this cut, giving them a dock front of about 2,000 feet, and the two or three owners of the islands would doubtless dock their front for a distance of from 1,000 to 1,500 feet, as it would make their property very valuable for lumber yards; but I did not see them after having thought of this plan of improvement, and therefore have nothing to base this opinion upon except the opinions of others and the fact that it would be so greatly to their interest.

Before leaving Plattsburg I submitted this plan to a company of gentlemen, including the member of Congress from that district and others largely interested in the commercial prosperity of the place, and they were unanimous in their approval of it as the best solution of the problem. It will much more than double the dockage front of the port at a trifling cost.

It is my judgment that the improvement is worthy of being made, provided rock does not interfere, though I am not sure but that the 25 feet adjacent to the proposed line of docks should be dredged by the owners of the docks as private property, as that portion will not be available for public use as a channel. This would reduce the cost to the United States to $30,000.

The commercial statistics of this port are not furnished, as they are contained each year in the Annual Report of the Chief of Engineers. I would estimate the cost of making the survey, maps, plans, and estimates at $250.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS.

SURVEY OF MOUTH OF THE SARANAC RIVER AT PLATTSBURG, NEW YORK.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., December 26, 1884.

SIR: I have the honor to submit the following report on the survey of the mouth of the Saranac River at Plattsburg, N. Y.

The present harbor of Plattsburg, which is very small, is an artificial one, protected by a breakwater. The extension of the breakwater will not add to the available harbor in any reasonable proportion to the expense, nor would the increased room be as conveniently located as if the harbor extension were made by excavating the river mouth. The present survey indicates that the harbor facilities can be increased to the same extent much cheaper by excavating an inner harbor in the river mouth than by extending the breakwater.

Under date of September 26, 1884, I submitted a report of a preliminary examination of this locality made by me personally, and I now forward herewith the report and map of a survey of the mouth of the Saranac River, just completed by Assistant Engineer L. Y. Schermerhorn.

The survey developed the fact that below a depth of 5 feet at low water the material to be dredged to make the basin or inner harbor is very hard clay mixed with stones. The bed-rock, that I had some fears of, shelves off in a way not to interfere with an inner harbor. The material to be dredged is about one-half soft mud, sand, and sawdust, and the other half hard clay mixed with bowlders, the dredging of which would cost more than twice as much as the soft material. With powerful dredges this harder material could be removed at but little extra expense, but the dredges on Lake Champlain are not adapted to such material, and, considering the uncertainty of the difficulties attending its removal, I would estimate the average cost of the dredging, including contingencies and superintendence, at 50 cents per cubic yard.

In my preliminary report I suggested the propriety of making an inner harbor, consisting of a channel 250 feet wide, supposing the islands to the north of the channel would be utilized for dock room. Upon further inquiry there seems no immediate likelihood of the northern side of the channel being docked, and as the dredging is so much more expensive than anticipated, I would propose to make the inner harbor only 150 feet wide, which will answer all the purposes of commerce if only the southern side is used for docks, and would probably answer even if the northern side were used. If the future developments of commerce should demand a greater width, which is extremely doubtful, it would be a simple thing to increase the width by dredging to the north of the channel before that side is docked. I would propose to run the southern line of the channel from the northeastern angle of the steamboat dock 1,500 feet westerly, dredging this to an average depth of 10 feet, so as to allow of a 9-foot channel at extreme low water, which rarely occurs. From the mouth of this inner harbor the channel would flare outward to the 11-foot curve, being about 400 feet wide at this curve, the dredging of this outer part being to a depth of 11 feet. The entire amount of dredging would be about 120,000 cubic yards, which would cost, at 50 cents a cubic yard, including contingencies and superintendence, $60,000.

This is essentially an extension of the project for improving Plattsburg Harbor, and I would suggest the propriety of retaining the former name of the appropriation.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. L. Y. SCHERMERHORN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., December 24, 1894.

SIR: I have the honor to submit the following report on the survey of the mouth of the Saranac River, at Plattsburg, N. Y.

The survey covered that part of the mouth of the river contained between the island and the south shore of the mainland, and from the Delaware and Hudson Canal Company's Railroad on the west to the 12-foot curve in Lake Champlain.

For the purpose of general information, soundings were made over the area in front of the steamboat docks, extending out to the 12-foot curve.

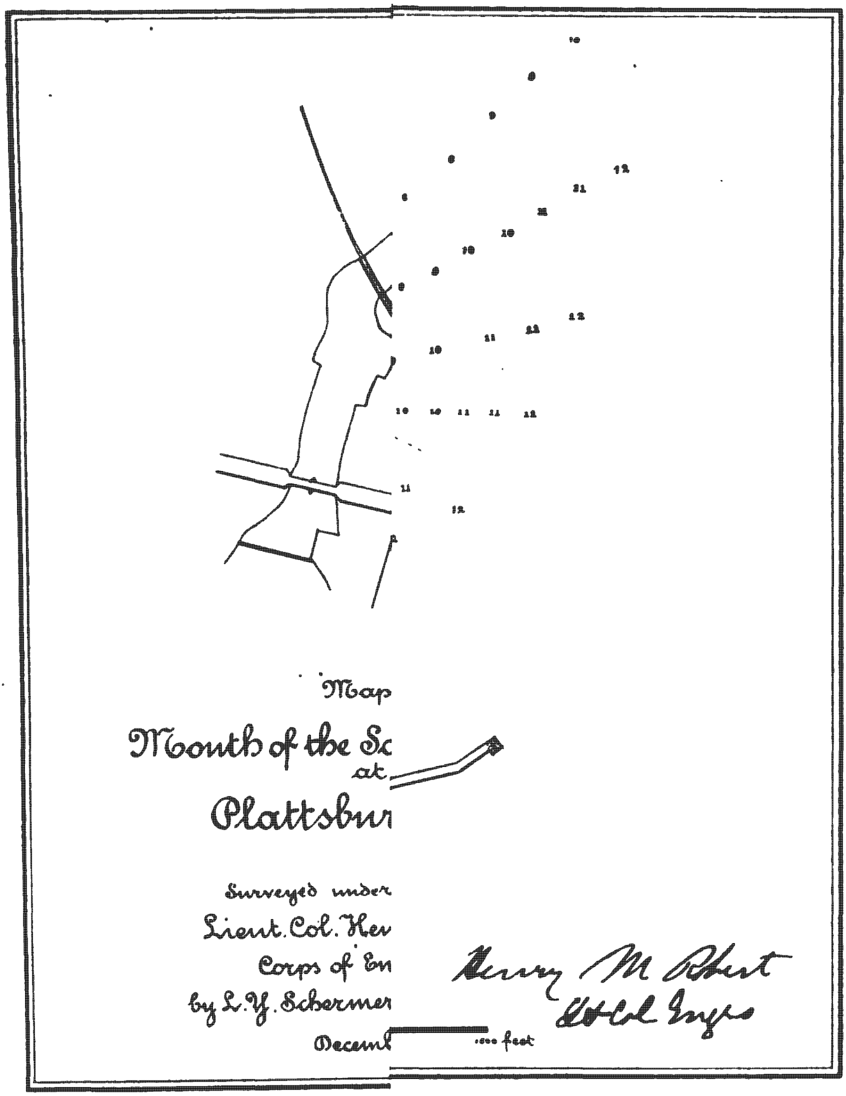
The Saranac River at the crossing of the Delaware and Hudson Canal Company's Railroad divides into two branches, of which the main branch passes north of the island. The survey did not cover this main branch, because it is extremely shallow and stony. Its vicinity is isolated from the commercial part of Plattsburg, and, in addition, access to any possible improvement therein located would be separated from deep water in Lake Champlain by shoals nearly one-half a mile in width.

The entire area of the river's mouth is very shallow, averaging about 2 feet in depth. The island that partly fills the mouth has an elevation of from 2 to 3 feet above low water, and is covered to a depth of over 3 feet at the high-water stages of the lake. The island consists of river detritus brought down at freshets. The general character of the mouth of the river, as determined by borings, was found to consist of mud, sand, and sawdust for a depth of about 3 feet, or to a depth of about 5 feet below the surface of low water. The borings were carried to a depth of 10 feet below low water, and the bottom below the mud, sand, and sawdust was invariably found to consist of clay, mixed with bowlders, into which iron bars could with difficulty be driven. At the mill-race, near the southwestern corner of the bay, the bed-rock rises to the surface, but with such a dip to the east as to carry it quickly beyond the depth of the borings made.

The clay and bowlder substratum above referred to is probably of the same character as that which covers the area in front of the steamboat wharves, and can be easily removed by suitable dredges.

Near the northern angle of the steamboat docks is a crib about 30 feet square, formerly used as an aid to steamers using this part of the dock. This crib would require to be removed in the proposed improvement.

The improvement which seems to be desired, and for which this survey was made, consists of a dredged basin 150 feet wide and 1,500 feet long, the south limit of which extends westerly from the most northerly angle of the steamboat wharves on a straight line towards the southerly end of the railroad trestle. To connect this basin with deep water in the lake a small amount of dredging would be required. To insure the entrance of tugs and vessels drawing 9 feet of water would require the excavation of the basin to a depth of 10 feet at low water, and the excavation to a depth of 11 feet of the connection between the entrance to the basin and deep water in the lake.



Map

Mouth of the Sa
at
Plattsbur

Surveyed under
Lieut. Col. Hen
Corps of En
by L. Y. Schermer
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Henry M Robert
Lt Col Engrs

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It is probable that the permanency of such a dredged basin would be increased by closing the south branch of the Saranac River at its point of division near the railroad bridge, so as to prevent freshets washing material into the basin from the contiguous shallow areas.

The formation of such a basin or inner harbor would permit the utilization of large adjacent land-areas for coal and lumber yards, and such other industries as might require accommodation. It is expected that the owners of the land adjacent to the basin would construct the necessary docks and slips.

The estimate would be as follows for a basin or inner harbor 1,500 feet in length, 150 feet in width, dredged to a depth of 10 feet at low water, together with the deepening to a depth of 11 feet of the connection between such a basin and deep water in the lake:

EXCAVATION OF BASIN.

	Cubic yards.
Mud, sand, and soft material	35,000
Clay mixed with bowlders	55,000

EXCAVATION OF APPROACH TO BASIN FROM THE LAKE.

Sand, gravel, and sawdust	20,000

In the foregoing estimate of quantities 25 per cent. has been added to place measurement to reduce it to scow measurement.

COST.

55,000 cubic yards mud, sand, and soft material, at 30 cents	$16,500
55,000 cubic yards clay mixed with bowlders, at 60 cents	33,000
Removal of crib near entrance to basin	1,000
Contingencies	5,500
Total	56,000

Very respectfully, your obedient servant,

L. Y. SCHERMERHORN,
Assistant Engineer.

Lieut. Col. HENRY M. ROBERT,
Corps of Engineers, U. S. A.

O O 12.

PRELIMINARY EXAMINATION OF MAQUAM BAY, SWANTON, VERMONT.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., October 24, 1884.

SIR: In compliance with your instructions dated July 31, 1884, I have the honor to submit the following report of the result of a preliminary examination made by me on the 8th instant of "Maquam Bay, Swanton, Vermont."

Maquam Bay is a portion of Lake Champlain near its northeastern end. Swanton is a town about 2 miles east of the bay. Swanton Harbor, or Maquam, as it is now called, is the portion of the bay nearest Swanton, and is the western terminus of the Saint Johnsbury and Lake Champlain Railroad, which, with the Portland and Ogdensburg Railroad, connects Lake Champlain with the seaboard at Portland, Me. Maquam itself is nothing at present but the point of transfer from the boats to the cars, and vice versa.

A survey of this harbor was made in 1872 by the Engineer Department, and a full report with all the facts bearing on the case published in the Annual Report of the Chief of Engineers, 1873, pages 397–402, to which I would respectfully refer. During my examination of the locality, I learned that the Saint Johnsbury and Lake Champlain Railroad had been completed, and that they proposed to build additional docks at once; that the improvement desired at this locality is the construction of a breakwater to protect the dockage front; that this improvement would be simply a modification of the present plan for improving Swanton Harbor, Vermont, and would take the place of that improvement.

At my request Mr. A. B. Jewett, the superintendent of the Saint Johnsbury and Lake Champlain Railroad, prepared a statement of the commerce that would be benefited by this improvement, concurred in by Mr. Folsom, superintendent of the Connecticut and Passumpsic Railroad, a connecting line, and also what the railroad company would do in regard to building docks. A copy of this statement is inclosed.

The railroad, of which Maquam is one terminus, will supply a large part of Northern Vermont and New Hampshire with its coal and iron and other articles that can be cheaply transported by water to Maquam. For lack of proper terminal facilities only 137 canal-boats, carrying 16,525 tons arrived at Maquam during the season of 1883. The railroad company's steamer makes daily trips across the lake, but cannot lie over night at Maquam for lack of proper protection. The entire commerce of this place is and will be carried on by canal-boats towed by steam tugs or barges. A breakwater built in water 18 feet deep, the greater part of it almost parallel to the shore, as at Oswego, would appear to accommodate the interests of such a class of boats better at the same expense than the present plan, which places the breakwater almost at right angles with the shore in water varying in depth from 23 to 30 feet. The 259 feet of breakwater now built in this harbor would be very useful as a protection from the great fields of ice that cause so much trouble here, but to obtain a given amount of protection I think it can be done more economically by placing the breakwater in shallower water under the protection of the old breakwater. Even with this plan the artificial harbor will have a greater width between the end of the docks and the breakwater than exists at Oswego, which provides for a much larger class of vessels.

In my judgment "Maquam Bay, Swanton, Vermont," is worthy of improvement. A new survey is not needed here for use in preparing plans, but if a survey must be made to conform to law, then I would estimate its cost, including preparing maps, &c., at $150. If the existing surveys will answer, and only maps, plans, and estimates are required, then I would estimate these to cost $50.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

STATEMENT OF THE SUPERINTENDENT OF THE SAINT JOHNSBURY AND LAKE CHAMPLAIN RAILROAD COMPANY.

SAINT JOHNSBURY AND LAKE CHAMPLAIN RAILROAD COMPANY,
SUPERINTENDENT'S OFFICE,
Saint Johnsbury, Vt., October 10, 1884.

DEAR SIR: Inclosed I send you tonnage at Maquam for season of 1883, and to October 1, 1884. Some of our heavy shipments are yet to come forward, and we shall have quite an increase over last year, in my opinion. I also send you section of map,* with a line drawn showing the section of Vermont and New Hampshire that the harbor at Maquam convenes. It comprises a territory nearly equal to one-half of the State of Vermont, with a population equal to two-fifths of the State. This territory will receive its supply of coal, iron, salt, and various other articles, from that port, and ship out spruce lumber, granite, the coarser farm products, &c. The tonnage will largely increase if the harbor is improved so as to be safe for vessels to lay there. As it is now, vessels do not consider it safe to remain there during the night unless they get under cover of the docks, and they are not extensive enough to afford protection to vessels larger than canal-boats. The steamer Maquam, that runs daily between this port and Plattsburg, is obliged to lay at the Plattsburg end of the line, while it would be largely beneficial to her business if she could lay at the Maquam end.

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* Map omitted.

The want of protection makes the cost of freight at this port from 15 to 25 cents per ton more than at corresponding places on the lake, which would be done away with if the protection was afforded. When the breakwater was located it was contemplated that the docks were to be extended further south, which has not been done for the reason that, there being no protection, they have been kept near together so as to afford the larger amount of cover for vessels. It is now arranged to build a new dock the coming season about 800 feet south of the present southerly dock, which point is about midway between the present docks and the breakwater. But if no extension is to be made to the breakwater, the new dock, like the present one, will have to be built of solid stone, to protect it from moving ice in the spring of the year, while an extension of the breakwater should protect a trestle dock, and save a large expense in building, as well as to make it far more serviceable, as an isolated dock without protection affords poor cover for vessels in rough weather.

The Saint Johnsbury and Lake Champlain Railroad, which cost about $4,000,000, was built with a view of furnishing this section of territory I have marked out with cheap lake freight both in and out, and unless protection is furnished its harbor, much of the money will have been spent in vain.

Perhaps I may add a word as to the manner of building the breakwater, as I have given it much thought and watched the working of the elements, as well as discussed it with several practical engineers. The plan first adopted was to build a crib 27 feet high and 25 feet wide, filled with loose stone. The foundation or bottom being soft clay, the ice shove in the spring pushed it over, sinking the lower corner deep into the clay. This plan was a total failure, and a large appropriation was lost. The plan now adopted, which is to fill with loose stone to within 4 or 6 feet of the water-level, and place a similar crib on top, has stood well and has every appearance of being all right. Another plan has been suggested, to build entirely of loose stone, without any crib, relying on the stone to resist the action of ice and water. This bay differs from most others, for the reason that the ice remains quite solid until after the water rises in the spring and, the winds shifting, moves the ice in different directions, thus pushing very hard against perpendicular sides; therefore, it is necessary to slope that part above low water, so that the ice will run up the slope and break. This is especially the case where the line of the work runs east and west. When the angle is turned and the work is north and south, the danger from ice will be far less. Trusting I have not trespassed too much on your time, and assuring you I shall be pleased to furnish you any information I can obtain,

I remain, with regards, truly yours,

A. B. JEWETT,
Superintendent.

COL. H. M. ROBERT,
United States Engineer.

The Connecticut River and Passumpsic Railroad crosses the Saint Johnsbury and Lake Champlain Railroad at Saint Johnsbury; extends from Newport to White River Junction. I have considered the above and consider it correct.

H. E. FOLSOM,
Superintendent Connecticut River and Passumpsic Railroad.

Tonnage at Maquam, Vt., from May 1, 1883, *to December* 1, 1883.

Articles.	Number of canal-boats.	Average tonnage per canal-boat.	Total tonnage per article.
		Tons.	*Tons.*
Coal	100	110	11,000
Iron	33	125	4,125
Sand	2	150	300
Hay	2	75	150
Merchandise by steamer Maquam, about 5 to 6 tons per day			950
Total tonnage			16,525

Tonnage from May 1, 1884, *to October* 1, 1884.

Articles.	Number of canal-boats.	Average tonnage per canal-boat.	Total tonnage per article.
		Tons.	*Tons.*
Coal	79	110	8,690
Iron	34	125	4,250
Sand	2	150	300
Hay	1	75	75
Spike, cement, &c	2	100	200
Marble	1	150	150
Merchandise by steamer Maquam, about 5 or 6 tons per day			730
Total tonnage			14,395

Tonnage from May 1, 1883, to October 1, 1883	14,2[illegible]0
Tonnage from May 1, 1884, to October 1, 1884	14,395

Correct.

A. B. JEWETT,
Superintendent.

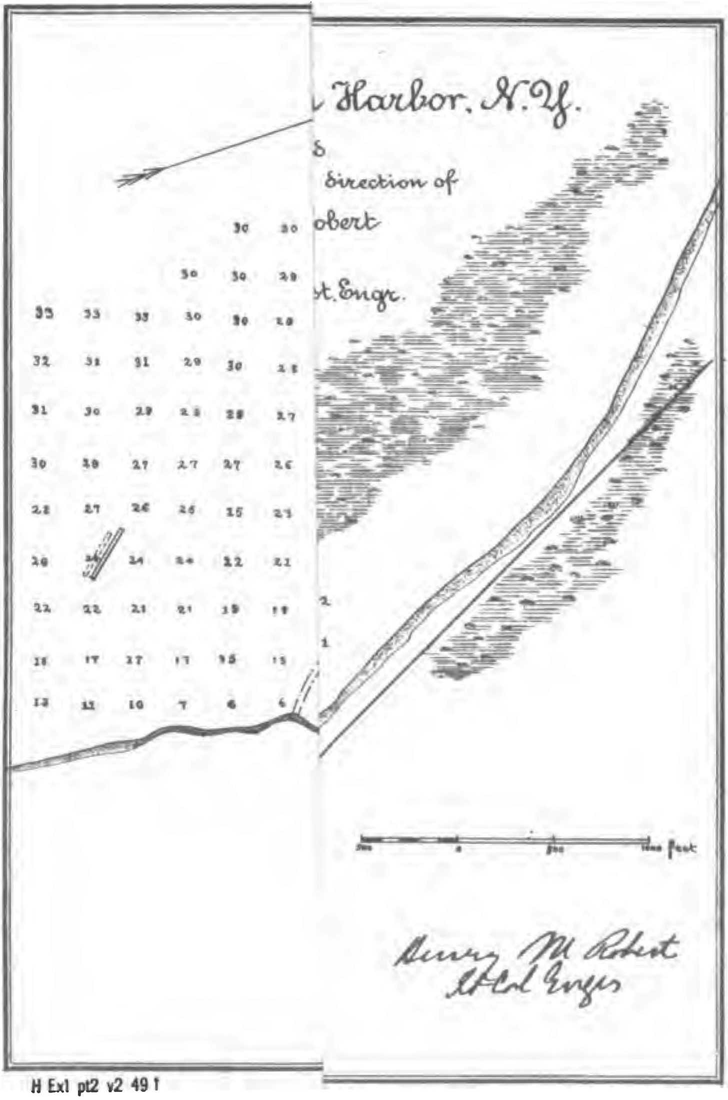
SURVEY OF MAQUAM BAY, SWANTON, VERMONT.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., January 5, 1885.

SIR: I have the honor to submit the following report on the survey of Maquam Bay, Swanton, Vt.

As stated in the report of my preliminary examination of this locality, a complete survey of this place was made in 1872, under the direction of General Newton. Consequently the present survey by Assistant Engineer L. Y. Schermerhorn was limited to a line about 700 feet from the shore, which appeared to be the best location for a breakwater.

The plan for the improvement of Maquam Bay proposed in the accompanying report of Assistant Engineer Schermerhorn seems to me, as well as to the parties most interested, to admirably meet the wants of this locality. The force of the waves is very slight at this place, but the ice is very troublesome, and the proposed breakwater would be protected from the ice in the most dangerous direction, the south, by its location and by the short piece of breakwater now built. By making the breakwater simply of random stone, with a thickness of 20 feet at extreme high water and about 50 feet at extreme low water, allowing the slopes to assume such shapes as the waves will give them, and placing the breakwater only about 700 feet from the shore and parallel to it, with an arm connecting it with the rocky point of the shore, the entire dock front of Maquam can be readily and cheaply protected. The portion of the shore south of the rocky point is scarcely available for dock purposes. About 2,500 linear feet of breakwater will be required, which, including superintendence and contingencies, I would estimate to cost about $56 per foot, or $140,000 for the entire breakwater. The expenditure of one-half this sum will give excellent shelter to all the dockage that will be required for several years, and the further expenditure of funds on this project should be contingent upon the requirements of commerce. In other words, $70,000 is all that is required to build a breakwater ample to provide for all the present requirements of commerce at Maquam, and this will do away with the necessity for further appropriation for the improvement of Swanton Harbor, Vermont



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(the two improvements being practically the same), of the estimated cost of which there remains to be appropriated $169,500.

There is forwarded herewith Assistant Engineer L. Y. Schermerhorn's report, with map.*

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. L. Y. SCHERMERHORN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Oswego, January 3, 1885.

SIR: I have the honor to submit the following report on Maquam Bay, Swanton, Vt.:

Maquam Bay is a deep indentation in the shore-line of Lake Champlain near its northeastern limits.

The only point on Maquam Bay where any improvement would be of utility is the east shore, at Swanton Harbor, Vermont, and the present consideration of Maquam Bay is applied to this point. In October, 1872, a comprehensive survey of this part of Maquam Bay was made by Assistant Engineer D. White under the direction of General John Newton, Corps of Engineers, United States Army, and it was considered that a resurvey was not required. In December, 1884, a brief examination was made to determine whether any important changes had ensued since the date of the survey, and also to ascertain the character of the bottom over the areas marked on the survey of 1872 as "mud." The map* herewith submitted is a copy of Mr. White's survey, except some added details relating to the present location and extent of docks and railroad tracks and of the breakwater built. The character of the bottom indicated as mud on that part of the survey of 1872 in front of the proposed docks was found to consist of about one foot of mud superposed upon firm sand of sufficient stability to resist the weight of any construction which would probably be placed upon it.

The improvement of this harbor was begun under an appropriation of $15,000 made in 1873, upon a project for the construction of a breakwater about 1,900 feet in length, located about 3,500 feet south of the then existing dock at Swanton Harbor. This proposed breakwater began at a point 900 feet from the shore, making an angle of about 70 degrees with the shore-line, along which the docks were expected to be placed. Its estimated cost was originally placed at $272,160, but was reduced to $240,000 in 1879. The total amount appropriated has been $70,500, leaving $169,500 yet required for its completion.

Between 1873 and 1878 about 250 linear feet of the eastern end of the breakwater were built. During this interval the work was so seriously injured several times by the movement of ice, that after the latter date the plan of construction was somewhat changed and further work transferred to a line parallel with and slightly north of the previous work. Since 1878, 309 linear feet of breakwater have been built upon this new line.

When the project for the improvement of this harbor was submitted in 1873 the officer in charge stated: "The principal demand for works of protection at this harbor refers to a future development of commerce due to the proposed completion of the Portland and Ogdensburg Railroad, and its connections with existing routes by water and rail." * * *

"It would be highly proper, if not essential, to require the parties interested to construct, first, the uppermost wharf, and then to commence the breakwater at the point nearest the shore, building it only so far, year by year, as would be necessary to cover the wharves as they are built in regular order from the first position as above described." Since 1873 the then projected railroad connections with Swanton Harbor have been completed, and with it has arisen the necessity for increased dock and wharf facilities. The present docks are about 3,500 feet north of the line of the breakwater; further dock extension would be entirely to the south and within a distance of about 2,000 feet, or to a point which would be separated by about 1,500 feet from the protection of the breakwater. The vessels to which shelter and protection are to be given will consist largely of barges and canal boats—principally the latter. By an extension of the breakwater as at present located the docks would be open to the west for a distance of from 3 to 4 miles. This, in the rough weather of spring and fall, would be very inconvenient and at times, hazardous, while it would preclude the use of the docks as winter quarters for vessels on account of the liability to dangerous movements of ice.

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* Map omitted.

In view of these facts and the probable economy arising from a modification of the present plan, there is suggested a breakwater nearly parallel with the shore-line, and directly covering, from both the south and west, the area to be devoted to docks and wharves. Such a breakwater would begin on the shore-line at a point 2,400 feet south of the present docks, and pass thence on the arc of a circle of 800 feet radius to a tangent about 700 feet from the shore-line; thence northerly, and about parallel with the shore-line to a point nearly abreast of the present docks. The trace of such a breakwater would be 2,500 feet in length, and, except for a short distance near the shore end, would lie in water, about 18 feet deep at mean low water. Its distance from the shore-line would permit the docks to be extended to 10 feet depth of water, and yet leave about 400 feet between their outer ends and the inner face of the breakwater. In addition to constructional advantages, the abundance and cheapness of stone in the vicinity suggest the formation of the breakwater entirely of rubble-stone.

The position of the 300 linear feet of the present breakwater would make it serve a valuable purpose as an ice-breaker to the shore end of the suggested breakwater; the direction of the main arm would give it great stability against the movement of ice from the direction most to be feared—the southwest; while the slope of its lake face would render it quite secure against ice movement from the west. A breakwater along the lines suggested would never be subjected to the effect of destructive wave action from the south, since its main arm would be nearly parallel with the line of movement of waves from that direction, and the limited reach from the west—less than 4 miles—would preclude destructive seas from that direction.

To assist in the determination of the slopes of a random stone breakwater, the following summary of water-levels on Lake Champlain is presented: The ice in the lake usually disappears between April 1 and May 1; the highest stage of water follows the disappearance of the ice and occurs between the middle of April and the last of May; the low-water stage is reached in September and October, and from this stage to the breaking up of the ice the water slowly rises, followed by an abrupt rise in April and May. Within the last twelve years the low water has reached a stage of five-tenths foot above zero five times, and a stage of 1 foot above zero seven times. During the same interval high water has reached a stage of from 4 to 5 feet above zero six times, a stage of from 5 to 6 feet twice, and a stage of from 6 to 7 feet above zero four times. From this it may be inferred that the difference between high and low water is about 7 feet.

The following is suggested as a cross-section for a random stone breakwater: A width at extreme high water, 7 feet above zero, of 20 feet; between high water and a point 3 feet below low water a slope of 2 horizontal to 1 vertical on the lake face, and 1½ horizontal to 1 vertical on the harbor face; below the plane, 3 feet below low water, the slopes to be 1 horizontal to 1 vertical on both lake and harbor faces; above the plane of extreme high water the stone to be sloped on each side so as to reach a height 3 feet at the center. By making the slopes at the beginning slightly steeper than those indicated above, the reserve material can be subsequently added to the upper parts of the work until the action of the forces impressed upon the breakwater result in such an adjustment of the material as will result in a stable equilibrium. Allowing for subsidence of 2 feet by sinking into the bottom, the volume of stone required for a breakwater on the foregoing described lines and with the cross-section stated, would be 125.000 cubic yards. It is believed that the protective position of such a breakwater would permit of its construction without using stone in larger individual masses than such as could be handled with the ordinary appliances for furnishing and placing crib-filling. A part of the larger stones furnished at the quarries might without increased expense be reserved for a top covering of the upper exterior slopes of the work.

The cost of the work I would estimate as follows:

125,000 cubic yards rubble stone, at 90 cents	$112,500
Contingencies	17,500
Total	130,000

The first 1,200 feet of breakwater could be built for about $55,000, and would immediately give full protection to docks built under its lee. The amount of breakwater to be built thereafter could be made dependent upon the development of the docks, and the commercial requirements of the harbor.

Very respectfully, your obedient servant,

L. Y. SCHERMERHORN,
Assistant Engineer.

Lieut. Col. HENRY M. ROBERT,
Corps of Engineers, U. S. A.

APPENDIX P P.

IMPROVEMENT OF THE HARBORS OF OAKLAND AND WILMINGTON; OF PETALUMA CREEK, AND OF THE HARBOR OF REDWOOD, CALIFORNIA.

REPORT OF LIEUTENANT-COLONEL GEORGE H. MENDELL, CORPS OF ENGINEERS, BVT. COL., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Oakland Harbor, California.
2. Wilmington Harbor, California.
3. Redwood Harbor, California.
4. Petaluma Creek, California.
5. Removal of sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

6. Islais Creek, San Francisco Bay, California.
7. San Mateo River, California.
8. Napa River, California.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 17, 1885.

SIR: I have the honor to transmit the annual reports for the year ending June 30, 1885, of the river and harbor works under my charge.

Very respectfully, your obedient servant,

G. H. MENDELL,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

P P 1.

IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

The present project looks to obtaining a ship-channel with 20 feet at low and 26 feet at high tide. There is now a ship-channel of 18 feet depth at high water from the bay of San Francisco to the water-front of Oakland. The corresponding original depth on the bar at the entrance was about 9 feet. The increase of depth has been secured by dredging and by the construction of two jetties extended into San Francisco Bay. The improvement of the channel has afforded much convenience to commerce, which is shown in the great increase of tonnage, elsewhere mentioned in this report.

The amount appropriated for this harbor, distributed over the years since 1874, is $874,600. The amount expended to the close of the fiscal year is $775,283.67.

THE OPERATIONS OF THE PAST YEAR.

The operations of the past year consisted in dredging a ship-channel in front of the city of Oakland 4,200 feet in length, 100 feet in width, to a depth at low water of 14 feet; in dredging the tidal basin, and in the completion of a part of the south jetty—all by contract. The first-named contract, made with Thomas H. Williams, was completed on April 7. It included 59,089 cubic yards of sand and clay, all of which was deposited on the adjacent shore by means of the hydraulic method first introduced on this work. The price paid for this work was 43 cents per cubic yard. The resistance of a part of the material approached the limit of practicability. This fact accounts for the price paid, which contrasts strongly with that of the contract of Edward G. Lukens, made October 4, 1884, for $11.95 cents per cubic yard. This contract includes about 800,000 cubic yards of mud to be placed ashore. Dredging was begun under this contract March 12, 1885, and at the close of the year 30,047 cubic yards had been excavated. The dredge was burned to the water's edge on the 19th June. Arrangements were made by the contractor under which the Von Schmidt dredge was put to work on July 1. This dredge has already proved its efficiency, so that the work will now progress more favorably. The contract work is now nearly 250,000 yards in arrears.

The contract with Edgar W. Emerson for furnishing and laying stone was completed on May 15; 16,685 tons of stone having been delivered, 101,617 square feet of facing having been laid during the year.

The stone was deposited on the south jetty, of which 2,300 linear feet were put in completed condition, with its faces laid in dry masonry. The quantity of stone required for this work exceeds the estimates, and 5,000 tons are yet required to finish the portion of the jetty laid out for completion last year, of which 818 feet remain unfinished. The method of finishing is to make the faces above low water of dry masonry, on a slope of about forty-five degrees. For this purpose large stones are used in the shape in which quarrying leaves them. They are well bonded into the wall and form a substantial finish. The land condemned for the site of the canal to connect the harbor with San Leandro Bay has come into the possession of the United States by payment into court of the sum of $39,600 appropriated by the act of July 5, 1884.

PRESENT CONDITION.

The completion of the ship-channel from the head of the jetties to Oakland wharves gives a continuous depth of 18 feet at high water from San Francisco Bay.

This depth holds only over a width of 100 feet, but there is a channel of about 14 feet depth at high water for a width of 300 feet. Depths have been maintained during the year. Near the head of the jetties and at the entrance, depth has been gained, while at an intermediate point the depth remains unchanged, the loss of about 2 feet reported last year not having been recorded. The excavation of the tidal basin during the year having been insignificant, improvement in the lower channels was not to be expected. A noticeable addition to the tidal prism ought to be made during the coming year, now that the prospect for accomplishing dredging is good.

The exterior ends of both jetties remain in the same condition—not raised to high-water mark. No work was done on them during the past year. It is not proposed to complete them until the operations looking to a further increase of tidal prism shall have been advanced.

FUTURE OPERATIONS.

The contract with Edward G. Lukens for dredging about 800,000 cubic yards will absorb the funds now available, and no other operations are contemplated for the coming year.

The features of the work which will demand attention in the future are the continued excavation of the tidal basin; second, the excavation of the tidal canal, the land for which was acquired during the past year, and, third, the completion of 818 linear feet of the south jetty left unfinished under the last contract.

The money next appropriated is to be applied to one or more of these objects, depending upon the amount appropriated.

The appended report of the Assistant Engineer, L. J. Le Conte, affords information in regard to the details of last year's operations and contains statistics of trade.

Oakland Harbor is in the customs district of San Francisco, at which port duties were collected during the past year to the amount of $6,610,808.

Money statement.

July 1, 1884, amount available		$63,950 29
Amount appropriated by act approved July 5, 1884		139,600 00
		203,550 29
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$104,238 96	
July 1, 1885, outstanding liabilities	7,965 48	
		112,204 44
July 1, 1885, amount available		91,345 85
Amount (estimated) required for completion of existing project		939,929 20
Amount that can be profitably expended in fiscal year ending June 30, 1887		300,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of bids for dredging channel in Oakland Harbor, California, opened March 25, 1884, by Lieut. Col. G. H. Mendell, Corps of Engineers.

No.	Names of bidders.	Price per cubic yard.
		Cents.
1	*Thomas H. Williams, jr	43
2	John Hackett	44
3	Allexey W. Von Schmidt	47

*Accepted.

Abstract of bids for dredging tidal basin in Oakland Harbor, California, opened September 23, 1884, at 12 m., by Lieut. Col. G. H. Mendell, Corps of Engineers.

No.	Names of bidders.	Price per cubic yard.	Remarks.
		Cents.	
1	Edward G. Lukens	11.95	Accepted.
2	Edgar W. Emerson	13	
3	Allexey W. Von Schmidt	16.2	
4	Thomas H. Williams, jr	17	
5	G. L. Long	17½	This bid was received through mail at 2 p.m.

Abstract of contracts made during the year for the improvement of Oakland Harbor, California.

No.	Names of contractors.	Date of contract.	Object and price.
1	Thomas Williams, jr	July 7, 1884	Dredging channel at 43 cents per cubic yard.
2	Edward G. Lukens	Oct. 4, 1884	Dredging tidal basin at 11.95 cents per cubic yard.

REPORT OF MR. L. J. LE CONTE, ASSISTANT ENGINEER.

SAN FRANCISCO, CAL., *June* 30, 1885.

SIR: I have the honor to submit the following report on the progress of operations for the improvement of Oakland Harbor during the fiscal year ending June 30, 1885.

At the beginning of the year two contracts were in force—one with E. W. Emerson, for furnishing stone and placing it on the jetties in the form of dry masonry facing; the other with Thomas H. Williams, jr., for excavating a ship-channel through the hardpan shoal extending along the city front of Oakland and placing the material ashore. Both of these contracts were completed during the fiscal year.

On the 4th day of October, 1884, a new contract was entered into with Edward G. Lukens for excavating a tidal basin in the inner harbor, the contract calling for the removal of about 800,000 cubic yards, all required to be placed ashore.

This contract was in force at the close of the fiscal year.

STONE WORK ON THE JETTIES.

The contractor, E. W. Emerson, who at the beginning of the fiscal year was furnishing stone and laying it up in the form of dry masonry, met with many unforeseen and expensive delays in the form of legal injunctions. Towards the latter part of September, 1884, an injunction was served against further operations in the main quarry at Telegraph Hill. This injunction could not be removed, and as a result the delivery of small stone selected from other inferior quarries dragged along until December 16, 1884, when the contractor lost one of his barges during a storm. On the 27th of December he made application for permit to quit work until the stormy season was over. Permission was granted and the delivery of stone and dry-masonry work both came to a standstill for the time being. On the 13th of January, 1885, however, the contractor obtained substantial aid from the Kelso Quarry, Telegraph Hill, and asked permission to resume work. Accordingly, work was resumed on January 15, 1885, and continued up to May 15, 1885, when the contract requirements for delivery of stone were fulfilled.

The work of laying up the large stone in the form of dry masonry facing, however, did not reach completion until June 16, 1885.

The total amount of stone delivered during the fiscal year was 16,684.9 tons, all of which was placed on sections 1 and 2 of the south jetty.

The total amount of facing work laid during the year was 101,611 superficial feet.

The present condition of the jetties is as follows:

NORTH JETTY.

This jetty was completed during previous year as far as present purposes require. No work or repairs of any kind have been done on this jetty during this fiscal year, and it may be said that it stands in substantially the same condition as existed at the beginning of the year. The dry masonry facing laid on the channel slope has answered its purpose well, and is still intact. The northerly slope along this portion of the jetty, which is simply loose riprap of moderate-sized stone, may need some trimming up with additional stone in coming years on account of the swells from northerly gales having a tendency to flatten the slope. This is a small matter, however, and needs no present attention.

SOUTH JETTY.

Section 1, extending from shore-line 3,884 feet, has had its crest raised up to 10 to 12 feet above low water during the past year. This section is all riprap work, and consumed some 4,000 tons nearly, whereas the last year's estimate was 3,000 tons. The reason for this increase was that winter storms added largely to the sandy fillings behind the jetty. These accretions continued to accumulate until the sand-drifts began to wash over the crest of the jetty and into the navigable channel-way. At the point where the south jetty meets the shore-line the old stone work became completely buried out of sight by the mass of sand-drifts. This necessitated greater width and height to the construction than was contemplated in last year's estimate. This section is now completed for all present requirements.

Section 2, some 5,529 feet long, has had about 13,875.6 tons of stone deposited on it, nearly all of which has been laid up in the form of dry masonry facing. Both the side slopes and crest of this section are to be faced with dry masonry. The remainder of this section yet unfinished on the completion of the contract was 36,000 superficial feet, which is equivalent to a further requirement of 5,000 tons of stone. The circumstances which account for the increased quantity of stone required on this section over and above that estimated for its completion in last year, namely, 10,000 tons, are substantially as follows:

The old masonry facing along the channel side of the jetty showed signs of lack of sufficient support at the footings, and it became necessary to add an apron of large stone at the base of the slope extending throughout the entire length of the section. This additional work was not found to be necessary at the foot of the slope on the south side of the jetty, although that face was exposed to the heaviest seas in San Francisco Bay. The experience gained on one slope could not be applied to the other. This footing apron, 6 feet wide and 5,529 feet long, when completed, will consume some 8,000 tons of large stone over and above the estimate submitted last year, making the revised estimate for completion, say, 18,000 tons, more or less.

Section 3.—This portion of the jetty was completed last year, and up to the close of the present fiscal year has been subject to no changes worthy of note. No work of any kind has been done along this section during the year.

SHIP-CHANNEL WORK.

The work of excavating a channel 100 feet wide, 4,200 feet long, and 14 feet deep at low water at and along the city front of Oakland, was completed on the 7th of April, 1885. The material taken from this excavation, in all some 59,089 cubic yards, was largely a hard tenacious sandy clay and proved to be very difficult material to work. The dredge used was what is known as the "Atlas dredge," a variety of the centrifugal pump dredges, in which a cutting apparatus excavates the material and feeds it to the pump, which in turn sucks it up together with a large percentage of water and forces it ashore through a suitable line of discharge-pipe floated partly on pontons and partly on shore.

The actual engine hours consumed in this work is 2,108, or an average of 300 cubic yards per day of ten hours. This is not a fair statement, however, because the dredge was built for soft digging, and during the first portion of the contract was unfit to cope with the material. After making proper modifications and increasing her power, she was able to excavate and put ashore, 600 feet distant, about 500 cubic yards in ten hours' run. On private work in this same material the Osgood dredge could not excavate and dump into scows more than 200 cubic yards per diem of ten hours. This would seem to show conclusively that the centrifugal-pump dredges, as a class, are fully able to cope with any material capable of being dredged by the old-style dredges. As a result of the completion of this contract we have now a navigable depth of 14 feet at low water, or 20 feet at high-water springs skirting along the city front. The benefits to be derived from this improvement are being felt already, as shown by the deep-draught vessels now coming in without breaking cargo. The banks of this excavation being abrupt and 6 feet in height, it will be necessary to mark the south bank with a line of spar-buoys.

TIDAL-BASIN WORK.

Operations for making a tidal basin in the inner harbor under contract with Edward G. Lukens did not begin until March 12, 1885, and under circumstances which were hopeless in the extreme. As in previous contracts on this work, the material excavated was required to be placed ashore behind suitable retaining embankments. The contracting parties attempted to convert a clam-shell dredge into a centrifugal-pump dredge by comparatively slight alterations. They made use of a small pump and a small suction pipe; but at the same time used a large discharge pipe to carry the material ashore. The attempt proved a total failure, and is instructive to this extent, that it shows conclusively that, for pumping mud, a large pump and large pipe are necessary in order to reduce friction and avoid liability to clog with refuse matter found in all dredged material.

Work on this contract dragged along until June 19, 1885, when, at 10.30 p. m., the dredge took fire and burnt to the water's edge. Arrangements are being made by the contractor to employ the Von Schmidt dredge, which did such good service on this work during the previous contract, by which it is understood that this dredge will undertake to complete the contract. Work will be resumed on the first of the coming year. The total amount of material excavated and put ashore under this contract was 30,047 cubic yards, representing three months' actual work, whereas the contract called for 45,000 cubic yards per month. The price paid for this basin work is 11.95 cents per cubic yard excavated and placed ashore. The measurement is made in the cut.

CHANNEL-WAY BETWEEN THE JETTIES.

No dredging or other work of any kind has been done in the jetty channel during the past fiscal year.

A special survey has just been completed, the results showing that the 16-foot water line in San Francisco Bay has advanced well into the mouth of the jetties, and at the inshore ends of the jetties the 16-foot water line from the inner harbor has advanced towards the mouth of the jetties several hundred feet. On the other hand, the portion of the channel midway the length of the jetties has remained about the same as last year, or 2 feet shoaler than when the dredges finished their work in June, 1882. The sandy deposit along this shoal region, however, is peculiar in this respect, that it is kept constantly in motion by the tidal ebb and flood currents, so that at no time does it remain at rest long enough to become compact. The sounding-rod sinks into it under the weight of the hand, and vessels drag their keels through it when drawing a foot more water than the sounding-pole showed. All these facts go to show a progressive improvement as compared with previous reports. The scouring out at the two ends of the jetty channel is undoubtedly due to the tidal-basin work in the upper harbor adding to the tidal prism, and I venture to predict that the shoaling above mentioned will entirely disappear when the tidal-basin contract now under way shall have been completed. It is estimated that when this contract is fufilled a grand total of 15 per cent. will have been added to the original tidal prism.

FUTURE OPERATIONS.

The small amount of additional work required to complete section 2 of the south jetty is that which calls for our first attention, otherwise the unfinished portions will be subjected to more or less displacement by winter storms, such as was experienced last year, and considerable work will have to be done over.

The next operations to be undertaken are such as will provide for further increase of tidal prism. This will be accomplished by continuing our work on the tidal basin, but most of all by cutting a tidal canal connecting Oakland Harbor with the estuary of San Leandro. The completion of this canal constitutes the great ruling feature in this harbor improvement, and work should be commenced as soon as practicable.

The completion of this canal will add largely to the tidal prism in Oakland Harbor, and thus tend to maintain the depth of water in the jetty channel.

COMMERCIAL STATISTICS.

Your attention is invited to the following statistics which have been collected, showing the importance of the general traffic which passed through the jetty channel during the past years:

Years.	Ferries.	Trips.	Passengers.	Tons freight.
1874	1	600	None.	60, 000
1878	3	5, 400	216, 240	120, 000
1882	3	8, 800	858, 352	1, 051, [illegible]
1883	3	9, 400	892, 210	1, 150, [illegible]
1884	3	8, 000	974, 901	1, 142, [illegible]
1885	3	8, 000	1, 558, 760	1, [illegible]

Traffic by vessels.

Years.	Number vessels.	Tons register.	Tons freight.
1874	1,415	70,750	94,300
1879	1,085	109,125	211,627
1881	1,129	129,714	173,448
1882	1,004	144,004	257,614
1883	1,031	143,886	215,829
1884	1,157	163,553	255,738

By combining the above quantities we have the following grand totals for the entire traffic passing through the jetty channel during the past year:

Before improvements, 1874.			After improvements, 1885.		
Traffic.	Passengers.	Freight.	Traffic.	Passengers.	Freight.
		Tons.			*Tons.*
By ferry	None	60,000	By ferry	1,558,760	1,202,230
By vessels	None	94,300	By vessels		255,738
	Total	154,300	Total	1,558,760	1,457,968

The nearest port of entry is that of San Francisco, distant 3 miles from mouth of jetties.

Port of San Francisco.

Items.	1883.	1884.
Vessels entering	900	880
Vessels clearing	845	841
Gross tonnage	1,944,142	1,916,642
Exports treasure and merchandise	$58,066,464	$54,982,588
Customs duties	$6,847,580	$6,610,808

Very respectfully, &c.,

L. J. LE CONTE, C. E.,
Assistant Engineer.

Lt. Col. G. H. MENDELL,
Corps of Engineers.

P P 2.

IMPROVEMENT OF WILMINGTON HARBOR, CALIFORNIA.

GENERAL STATEMENT.

The present project is intended to increase by 4 to 6 feet the low-water depth of 10 feet which has been maintained for a number of years. The present maximum draught with which vessels can enter the harbor is 15 to 16 feet. The proposed increase, when secured, will enable vessels of 20 to 22 feet draught to enter at high tide.

The increase of depth is expected to result from the completion and extension of existing jetties combined with dredging, the two kinds of operations to be prosecuted simultaneously.

The total amount of appropriations made for this work, beginning in

1871, is $705,000. The amount expended is $664,833.15. 1871 the harbor, then in a state of nature, had a low-water depth at its entrance which varied a little on either side of 1 foot. The present low-water depth of 10 feet has been established several years. In 1871 no seagoing vessels could enter the harbor, and freight and passengers were taken from vessels anchored in the bay of San Pedro, and were carried ashore on lighters. Now a vastly increased coasting trade is carried on by vessels discharging at wharves within the harbor, and connecting with the southern overland railway system.

OPERATIONS OF THE PAST YEAR.

The act of July 5, 1884, appropriated $50,000, an amount not large enough to permit operations to be carried on as designed—that is, by dredging and jetty work combined. Bids for dredging were, however, twice solicited. The first call brought one bid; rejected as being unreasonable. The second call brought a bid about one-half the price of the first, to do the work by hydraulic dredging, which method required the dredged sand to be deposited behind the jetties. No contract was entered into, for the reason that a full consideration made it evident that in the existing condition as to height of the jetties more or less sand after being deposited would be liable to be returned to the harbor. At the same time it became necessary to construct a dike of stone for the protection of the southern end of Rattlesnake Island, which has been undergoing abrasion under the action of waves for several years. It had been hoped that the abrasion would cease and that a restoring action would set in, causing the sand to form, in extension of the island, as had been the case in the earlier history of the work. This hope was not realized, and it seemed hazardous to wait longer. The cost of this dike, subtracted from the appropriation, left a sum too small to justify a contractor in establishing a dredging plant at a point so remote, and in this way it became to the advantage of the work and the bidder not to enter into contract.

The appropriation was, however, held intact, until it became evident that no additional sum would be obtained during the last session of Congress, and on March 24, 1885, a contract was made with Edward A. Von Schmidt for the delivery of 18,000 tons of stone, more or less, to be applied to the construction of a dike about 700 feet in length and to raising the jetties to high-water mark. Operations under this contract were begun on May 1, and on June 30 5,284 tons were delivered, of which 3,489 were used on 450 linear feet of the dike, completing 320 feet. The remainder, 1,795 tons, was placed on the main jetty, raising 230 linear feet, about 6 feet in height to full high water.

Previous experience in the failure of contractors to place stone satisfactorily led to the adoption of hired labor for this part of the work. Preparations were made by building two new lighters and repairing three others and providing a suitable equipment.

The contract will expire during the present calendar year, and but ney will be carried over for next year's operations.

THE PRESENT CONDITION.

A hydrographic survey made at the close of the year shows some improvement in the development of the interior channels, a larger deposit of sand at the entrance making the bar wider and a change of direction in the channel over the bar. The depth at the entrance, however, remains the same, namely, 10 feet at low water. This fact confirms the views before expressed in these reports, to the effect that 10 feet at low water is the limit of depth to be expected in the present condition of the harbor, and that increase of depth can be obtained only by further extension of operations.

There is no change in the condition of the jetties worthy of special notice. The east jetty now stands at a level of 2 to 3 feet above low water, and requires to be raised 6 or 7 feet to reach high-water mark. The profile as constructed is indicated by these dimensions, namely: width on top 10 feet, outer slope 1 on 2½ base; inner slope 1 on 1. The exposed portion of the wall is to be made of stones 2 to 4 tons in weight. The dike as built has generally the same character of slopes and material with a width of 6 feet on top, which is placed at full high-water mark. The height of the dike is in general about 9 feet.

FUTURE OPERATIONS.

The estimate submitted in report for 1881 for securing the maximum depth of 15 or 16 feet at low water, which is regarded as the limit of improvement, now requires some modification owing to changes in circumstances. The material dredged from the reef then anticipated to be suitable for extending the west jetty was mostly found to be unsuitable and it was not used for the purpose.

The stone which this material was then expected to replace will now have to be purchased. The delay in the work due to want of appropriations causes changes of conditions and adds considerably to contingent expenses. The work was estimated in 1881 to be done for $291,766.42 in two years' time. Four years have now elapsed, and in that time $150,000, one-half of the estimate, has been appropriated. The delay has permitted the sand from the interior channels to take a new position at the entrance from which its removal will be more expensive than if its position had remained unchanged.

The harbor is quite remote from industrial centers, and there is considerable uncertainty as to the prices it may be necessary to pay. The bids for dredging opened during the past year were higher than was anticipated. There is little competition to be expected in dredging of this character.

Under these circumstances it becomes necessary to increase the estimate heretofore submitted. It now seems probable that $250,000 will be required to complete the present project. If the amount were given in two successive appropriations the work would be done in three years. The project contemplates dredging the channel, including the outer bar, widening the cut through the reef from 330 feet to 400, the extension of the west jetty a distance of 1,000 feet, and the elevation of about 1,500 feet of the west jetty to high-water mark. If the appropriation shall be sufficient, contracts will be made both for dredging and for jetty work.

Wilmington is a port of entry. The amount collected for customs during the fiscal year was $47,207.99.

Reference is made to the accompanying report of Assistant Engineer W. P. Smith.

Money statement.

July 1, 1884, amount available		$17 87
Amount appropriated by act approved July 5, 1884		50,000 00
		50,017 87
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,851 02	
July 1, 1885, outstanding liabilities	7,258 70	
		17,109 72
July 1, 1885, amount available		32,908 15

Amount (estimated) required for completion of existing project..........	$250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	150,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for delivering stone in Wilmington Harbor, California, for the breakwater, opened March 21, 1885, *at* 12 *m., by Lieut. Col. G. H. Mendell, Corps of Engineers.*

No.	Names of bidders.	Price per ton, 2,240 pounds.	Remarks.
1	Edward A. Von Schmidt*	$1 97	Accepted.
2	Edgar W. Emerson	2 29	
3	John Calvert & W. S. Fielding	2 68	Informal; not signed by both parties
4	San Francisco Bridge Company	3 44	

* Contract awarded to Edward A. Von Schmidt, dated March 24, 1885.

Abstract of bids for dredging in Wilmington Harbor, California, opened September 10, 1884, *at* 12 *m., by Lieut. Col. G. H. Mendell, Corps of Engineers.*

No.	Name of bidder.	Price per cubic yard outside.	Price per cubic yard inside.	Remarks.
1	William D. English	$2 00	$1 00	Rejected.

Abstract of bids for dredging in Wilmington Harbor, California, opened September 24, 1884, *at* 12 *m., by Lieut. Col. G. H. Mendell, Corps of Engineers.*

No.	Names of bidders.	Price per cubic yard outside.	Price per cubic yard inside.	Remarks.
1	John C. Benson & John H. McNee...	$0 99.99	$0 49.99	Accepted, but no contract made
2	William D. English	1 80	80	

REPORT OF MR. WILLIAM P. SMITH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
San Pedro, Cal., June 30, 1885.

SIR: I have the honor to submit the following report on the operations for the improvement of Wilmington Harbor, California, for the fiscal year ending June 30, 1885.

The last work done towards the improvement of the harbor was a dredging contract for widening the channel through the reef, which was completed December 14, 1883.

No appropriation having been made for the next fiscal year it was decided to expend the available amount of $50,000 in stone. Had an appropriation been made for the year ending June, 1886, it was the intention to let with the combined sums a contract for dredging a channel through the sand forming the present outer and inner bars. Bids for the delivery of stone in the harbor were invited, and on March 24, 1885, a contract was let to E. A. Von Schmidt for $1.97 per ton of 2,240 pounds. By the terms of the contract the first stone were delivered on May 1, and placed on the last training-wall connecting the outer end of the timber line with Deadman's Island. This wall is 1,800 feet long, and although when built was between 4 and 5 feet above low water, it has now spread out and settled until it is only between 2 and 3 feet above low water. A large portion of the water entering and escaping from the harbor over this wall, the scouring effect of the current is thus in a great measure lost.

The same conditions apply to the west training-wall. It has also settled until it is but little over 3 feet above low water.

The contract let was for 18,000 tons of stone, and this quantity, it was estimated, would raise the east wall to between 8 and 9 feet above low water, with a sufficient cross-section to resist the sea. If not deemed expedient to raise the entire length at once, other walls will be started or raised.

Under former contracts for the delivery of stone in this harbor the contractor was required to place the stone with his own men and plant.

The work has invariably been delayed from want of experience and the proper appliances in taking the stone from the vessels, bringing them into the harbor, and landing them in such places and form as required. Shoal water necessitating tide work, heavy swells at times, and not knowing what to prepare in lighters, derricks, and engines, have caused delays and loss of money to previous contractors, thereby making a poorer quality of work, and the contingent expenses of the work greater than they should be.

To avoid this it was decided to let the contract for the delivery of the stone onto lighters belonging to the United States, and to place the stone by hired labor. For this purpose two new lighters were built and three old ones repaired. A derrick and engine was placed on one capable of handling any stone that may be delivered, and it is proved to have been a profitable course on the part of the United States. Heretofore vessels have laid in the harbor for several days waiting to be discharged, but in this contract there has not been an hour's delay for want of lighters.

Stone were placed on the east wall until the 25th of May, after 1,795 tons had been delivered, and 230 feet of the wall had been raised to the required height and size. The smaller stone were put on the bottom, and the top and slopes formed of large stones from 1 to 3 tons weight. Work on the east wall was suspended to build a spur-wall on the outside of main line, starting from a point 600 feet outside of the high-water line of the extremity of Rattlesnake Island, and extending in an easterly direction nearly at right angles to the line of breakwater parallel to line of beach. The wall is laid out 500 feet long, but will probably be extended 100 feet or more. The object of this spur-wall is to assist the extension of Rattlesnake Island by the accumulation of sand on the outside of the breakwater.

For several years the end of the island has been washing away until about 400 feet more of the single line of timber work is exposed to low water and below than was some five years ago. It is expected that the space between the new spur-wall and the beach will gradually fill with sand. The sand on the line of this wall when started was 1 foot below low water.

Several attempts have been made with structures of brush to collect the sand on the end of the island and along the line of breakwater, but the favorable results were only temporary, and a riprap wall of this nature seemed be the only means left to build out the beach and hold it.

At the end of the year, 3,488.76 tons of stone had been used in this wall, which had built a foundation 455 feet long of small stones 40 feet in width and about 3 feet high. For 320 feet of this distance the wall is completed with large stone, making it 6 feet wide on top and 8 feet above low water.

One thousand seven hundred and ninety-five tons used on the east training-wall and 3,488.76 tons on the spur wall make 5,283.76 tons delivered to the end of the year under the present contract.

A sketch of the harbor accompanies this report, showing soundings taken in the latter port of June, about eighteen months having passed since the last survey.

The same depth of water is found over the outer and inner bars as there was one year ago, viz, 10 feet. The inner bar has improved slightly, but the outer bar has extended seaward and to the east, and the distance between the 12-foot curves on the outer bar is now about 100 feet greater.

The inner bar has remained as it now is during the year, but the outer bar has at times during the year had 1 foot, and some think over 1 foot, less than it now has. No survey was made, except the present one, during the year. The outer bar has shown indications of scouring during the last month or since the stones were put on the east training-wall. The sandy bottom of the bar is now quite irregular in depth and is getting softer.

The spur-wall will take about 1,000 tons more of stone and this will leave of the present contract some 12,000 tons more to put on the east wall. This will no doubt increase the scouring effect of the ebb tide sufficient to increase somewhat the depth of water on both the outer and inner bars, or certainly to straighten the channel which now takes a turn around Deadman's Island, deflecting nearly forty-five degrees to the left. This turn in the channel increases the difficulty of large vessels entering the harbor. The area of shoal water having increased makes more swell at times, which, with the crooked channel at the entrance, prevents the full depth of 10 feet at low water from being at all times available.

The channel inside of the inner bar has changed but little during the year. The sand-spits have extended out toward the channel in places and receded some in others. On the whole the inner channel is rather better defined and has in places straightened. Where the spits have approached the channel the banks are bold. We notice the most change in the sand-spit in front of Timm's Point.

The following statistics of the commerce of the harbor show a decrease in number of vessels over the previous year but an increase in number of steamers—an increase in coal imported and decrease in amount of lumber and merchandise. The exports have increased and revenue decreased. The principal revenue is from coal imported, but during the year nearly 20,000 tons were brought from Washington Territory.

Of the vessels that arrived, one hundred and twenty-five steamers, eight barks, all the brigs and all the schooners came inside and discharged cargoes at the wharves. This shows an increase in proportion of vessels, especially steamers, that now do not have to lighter outside the bar.

Vessels have entered drawing 14 feet 10 inches of water on a 5-foot tide. We have had 7 feet of tide.

STATISTICS WILMINGTON HARBOR, CALIFORNIA.

[From January 1 to December 31, 1884.]

Arrived.	1884.	[illegible]
Steamers	167	[illegible]
Ships	34	[illegible]
Barks	19	[illegible]
Schooners	156	[illegible]
Brigs	11	[illegible]
Barkentines	....	[illegible]
Total	387	[illegible]

IMPORTS.

Lumber	feet..	49, 056, 274	[illegible]
Coal	tons..	78, 553	55, [illegible]
Merchandise	do...	26, 517	[illegible]

EXPORTS.

Grain	tons..	9, 009	4, [illegible]
Fruit and honey	do...	284	....
Merchandise	do...	2, 100	1, [illegible]

Receipts for customs for fiscal year ending June 30, 1884 .... $58, 558 [illegible]
Receipts for customs for fiscal year ending June 30, 1885 .... 47, 207 [illegible]

Respectfully submitted.

W. P. Smith,
Assistant Engineer.

Col. G. H. Mendell,
Corps of Engineers, U. S. A.

P P 3.

IMPROVING HARBOR AT REDWOOD, CALIFORNIA.

The act of July 5, 1884, appropriated $3,000 for this work. The amount being insufficient to produce a good result, it has been held intact. The estimate for the work is $15,400. The whole amount is necessary in order insure a contract.

The work is to consist in dredging, 40,000 yards being estimated, as required to enable vessels drawing not more than 7 feet to reach the town front of Redwood City.

Money statement.

Amount appropriated by act approved July 5, 1884	$3,000 00
July 1, 1885, amount available	3,000 00
Amount (estimated) required for completion of existing project	12,400 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	12,400 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

P P 4.

IMPROVEMENT OF PETALUMA CREEK, CALIFORNIA.

The completion of this work as projected was reported in the last Annual Report. No work was done during the past year, and none is now expected for the coming year.

The total appropriation for the work was	$30,000 00
The total expenditure was	27,656 91

Money statement.

July 1, 1884, amount available	$2,343 09
July 1, 1885, amount available	2,343 09

P P 5.

REMOVING SUNKEN VESSELS OBSTRUCTING OR ENDANGERING NAVIGATION.

ESCAMBIA.

The last Annual Report stated that there was at low water a depth of at least 33 feet over the wreck of the *Escambia*, a result obtained from careful sounding, dragging, and diving. Nothing has since been learned that lessens confidence in this result, and the wreck is now not considered to be a danger to vessels. Nevertheless, to make assurance doubly sure, it was and is intended to make another examination. The light-house steamer Manzanita was kindly offered for the purpose by Commander Philip, United States Navy, light-house inspector, but the absence on other duty at the time the vessel was available of assistants having the particular experience needed for an examination compelled its postponement.

DREDGE IN SAN JOAQUIN RIVER.

The dredge used by the first contractor for making a cut-off at the Devil's Elbow, on the San Joaquin River, was sunk at the mouth of the proposed new channel about May 14, 1884. The contractor having failed to take measures to remove the dredge, he was urged to do so on June 12, and again on July 3. During July the owners began to attempt to raise the barge. Desultory and trifling efforts continued to be made, with much interruption. The dredge by its position was an obstruction to the navigation of the river and an inconvenience to the operations of the second contractor who on default of the first had undertaken to make the cut-off. In August bids were invited for the removal of the scow and machinery, in accordance with the terms of the act approved

June 14, 1880, and of the act of August 2, 1882. The owners kept a work, however, just enough to enable them to claim that they had not abandoned the dredge. Under the circumstances the contract could not be awarded.

The owners finally removed all that was worth the expense, and left the barge on the bottom in a broken and worthless state. The snag-boat Seizer removed the fragments in January, 1885.

The expenditure during the year was $86.89.

P P 6.

PRELIMINARY EXAMINATION OF ISLAIS CREEK, SAN FRANCISCO BAY, CALIFORNIA.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., November 18, 1884.

GENERAL: After an examination of Islais Creek, California, as required by the act of Congress of July 5, 1884, the following report is respectfully submitted.

Islais Creek lies within the territorial limits of this city, and within the jurisdiction of the State Board of Harbor Commissioners, which control the water front of San Francisco. The mouth and that portion of the creek which is in any sense navigable lie about 3 miles to the southward of the central part of the city. But for the tide there could be no navigation of the creek. The tide, which rises from 4 to 7 feet at neaps and springs, ebbs and flows now over about a mile of length of the estuary adjoining the mouth, which is in San Francisco Bay. In the natural state of the estuary the tide reaches a point 2 miles above the mouth, but is now intercepted by a causeway embankment across the creek on the line of Fifteenth avenue, a mile above the mouth. This causeway was made in 1878, under the authority of an act of the legislature of the State passed in 1876. It now forms one of the lines of communication between the city and a suburb known as South San Francisco. This road is, to the degree that it reduces the volume of tide circulation in the estuary, an injury to the channel of the creek. A second road, known as the San Bruno, crosses the creek by a bridge about 3,000 feet above Fifteenth avenue. This road was built in 1858, under authority of an act of the legislature of the State. It is thought not to be injurious in its effect upon the navigable value of the estuary.

The creek or estuary debouches into San Francisco Bay over a wide flat in part bare at low tide. Kentucky street crosses this flat about 1,500 feet outside of the mouth and forms an effective barrier to the navigation of the creek. The roadway is of timber, and is supported on piles. It has no draw-bridge. This street is a much-used line of communication between the city and South San Francisco. It was until recently a route of street-car travel. The rails have, however, been taken up.

Kentucky street was extended across and in front of the mouth of Islais Creek in 1868, under authority of an act of the legislature of the State dated April 2, 1866; amended by an act dated March 28, 1868, which contained the following words, namely: "Provided that the said railroad company (Potrero and Bay View Railroad Company) shall be required to construct a draw in the bridge on Kentucky street at its intersection with Tulare street (Islais Creek), whenever the parties interested shall pay the expense of constructing such draw, and provide for the maintaining of same."

An act of the legislature of March 26, 1868, declared the creek between the mouth and Franconia Landing to be navigable, with a proviso that nothing in the act shall affect the rights of the Potrero and Bay View Railroad Company, and that this company shall not be required to build a draw or pay the cost of maintaining a draw.

Franconia Landing was about one-fourth of a mile above the mouth. The portion of the creek proper declared navigable was, therefore, about one-fourth of a mile in length.

In 1880 the Board of State Harbor Commissioners brought suit in the State court against the Potrero and Bay View Railroad Company, alleging in the complaint that Islais Creek is and has been, from time immemorial, a navigable stream; that the defendant has obstructed it by building a bridge on piles over the channel, and has thereby damaged the commercial interests of the city, and asked the court to adjudge the bridge to be a public nuisance.

The court held that Islais Creek has been a navigable stream since 1850, and that the acts of the legislature of April 2, 1866, and March 28, 1868, authorizing the construction of the bridge, are in conflict with the Constitution of the United States, and with the act of Congress admitting California into the Union.

The court decreed the bridge to be a public nuisance, and ordered the defendant to remove it without delay. The defendant appealed the case to the supreme court of the State, which, so far as is known, has not acted on the appeal.

The harbor line as now established and shown by the official map of the State Harbor Commissioners is fixed about half a mile outside of Kentucky street, and a channel 200 feet wide is adopted for Islais Creek. The sea-wall to occupy the harbor line is not here built, and will not be for many years.

Of course there has been no navigation of the creek since the construction of the Kentucky Street Bridge in 1878. Prior to that time a few small cargoes in vessels of draught not greater than the rise of the tide are said to have been delivered at Franconia Landing. The improvement of the creek by a draw in the Kentucky Street Bridge, and the dredging of the channel at a reasonable depth, doubtless would restore this trade, and perhaps increase its volume. There are several small factories of leather and chemicals on the shores of the estuary which perhaps would receive supplies and ship products by water, and save thereby a cartage of 3 or 4 miles. It is also possible the improvement would lead to the establishment of new and large factories. Nevertheless, the advantage likely thus to be gained for commerce seems, under present circumstances, to be of too small proportions to justify the considerable expenditure that would be required to build and maintain one or more draws and to dredge the approaches to the creek. The complications already mentioned, caused by the State having authorized the construction of thoroughfares across the channel, seem to be an additional reason why it is not expedient at present to undertake the improvement of the creek.

At some future time, when complications shall cease to exist, and when there shall appear to be a real need for increased commercial facilities, Islais Creek may be worthy of improvement, but under existing circumstances it is not so regarded.

Very respectfully, your obedient servant,

G. H. MENDELL,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

P P 7.

PRELIMINARY EXAMINATION OF SAN MATEO RIVER, CALIFORNIA.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., September 19, 1881.

GENERAL: Having made a personal examination of San Mateo River, California, I have the honor to submit the following report.

San Mateo River, or Creek, as it is known in California, discharges into San Francisco Bay about 15 miles to the southward of this city. It drains perhaps 30 square miles, and during the rainy season, for a short time, it carries a large quantity of water.

During the greater part of the year there is a little or no drainage water in its bed. The tide naturally ebbs and flows for a mile above its mouth, making a bit of estuary lying in a strip of marsh land bordering San Francisco Bay.

The accompanying tracing of a Coast Survey map made about [illegible] shows the local surroundings, the village of San Mateo, the marsh lands with its various sloughs, Point San Mateo, and the outlying flat on the border of San Francisco Bay. The dam and private landing are shown in approximate location as recently observed.

A half mile above the mouth of San Mateo Creek is shown a landing, or *embarcadero*, connected with the village of San Mateo by a road about a mile in length. In former years this landing was in use, and small craft which at high water were able to pass the outlying flat, but in the lower stages of the tide, could make this landing. The adjoining land is marsh, standing at the level of ordinary high water and a foot or two below the level of spring tides. Some years ago the owner of the land shut off the road, which since that time has not been in existence. Nor has navigation existed for a number of years, the creek having been closed and the tide shut out by a dam of earth at its mouth, which dam still stands. The object of the dam was to compel the freshet waters to spread over and deposit their silt upon the adjoining marsh. This operation appears to have been successful in raising and reclaiming the marsh, but necessarily at the sacrifice of whatever navigable value the creek may have possessed.

Within a few hundred feet to the east of the mouth of San Mateo Creek a large slough joins San Francisco Bay. Near its mouth is a landing and warehouse, which serve to accommodate the same class of vessels that formerly were able to reach the *embarcadero* on San Mateo Creek.

This is a private landing in this sense, that the road connecting it with the village, a mile distant, is a private road, open to use only by permission of the owner of the land.

The slough is larger and longer than San Mateo estuary, and naturally carrying more tidal water, ought, in the nature of things, to afford more convenience to navigation.

Point San Mateo, on the bay, nearly 2 miles distant from the village, has, near shore, by the chart, 3 or 4 feet at low water. This point can be occupied conveniently by a landing, giving better water than formerly existed at San Mateo Creek, and better than can now be obtained without a large expense in establishing and maintaining navigation. It is understood that an effort is now in progress to establish a road from the village to this point, with a view to secure an outlet by water. This effort is resisted by owners of the land.

These two better alternatives being open, and either available when road can be established connecting with either point, there seems to be no good reason why the United States should bear the considerable cost of reopening San Mateo Creek, which, when done, would be under the same embarrassment that now deprives the other landings of their public value—namely, the want of a connecting road.

Under these circumstances it is thought that San Mateo River is not worthy of improvement.

Very respectfully, your obedient servant,

G. H. MENDELL,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

P P 8.

PRELIMINARY EXAMINATION OF NAPA RIVER FROM THE MOUTH TO NAPA CITY, CALIFORNIA.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., October 1, 1884.

GENERAL: Having made a personal examination of Napa River or Creek, and such inquiries as are practicable at present into the condition of trade, I express the opinion that Napa River is worthy of improvement. The greater part of the commerce of the town or city of Napa, and of the country adjoining, appears to be carried by the river. The town contains four thousand or five thousand people, a few manufactories of leather, woolen goods, wine, and flour. It is a depot for wines, which form a considerable part of the trade, which supports two steamboats and a number of sail vessels.

The statistics of this trade it has not been practicable to obtain in time for this report.

The river proper, as known among navigators, is about 14 miles in length in its navigable part. It is thought best to make a plane table survey of the banks and the necessary hydrography. The obstructions now known from inquiries lie in the upper 4 miles, but experience shows that new improvements develop new necessities. Therefore it is preferred to make a survey from Napa to the mouth, and for this purpose $500 will be required. It is requested that the money may be remitted at once.

Very respectfully, your obedient servant,

G. H. MENDELL,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF NAPA RIVER, CALIFORNIA.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., January 29, 1885.

GENERAL: Inclosed is a report of the survey of a portion of Napa River, made during the month of December, 1884, under the direction of this office, by L. J. Le Conte, assistant engineer, The allotment of $400 for the purpose of the survey did not permit the whole length, 14 miles of navigable river, to be covered. The survey made extends from Napa City, the head of navigation, for a distance of 7½ miles to a point nearly 2 miles below Suscol Ferry, leaving unmeasured about 7 miles of the lower part of the river. There is, however, no present complaint of obstructions in the part unsurveyed. It has not been possible, with the funds available for the purpose, to complete the map, although it is in condition for present reference.

The recommendations of this report apply to the portion of the river surveyed.

Napa River is during the summer and autumn mainly a tidal stream, carrying little drainage from its tributary basin. During winter and spring, which is the rainy season, it carries the drainage of a basin of about 400 miles square. The land drainage alone might afford a fitful and uncertain navigation for a part of the year, but it is the daily influence of the tide which gives the river permanent value for navigation.

The rise of ordinary tides at Napa City is about 5 feet, and of spring tides about 7 feet.

The river is subject to considerable freshets, which bring from above floating trees and detritus, composed in part of gravel, which settles to some extent in the channel and forms shoals. The general low-water depth within the limits of the survey is about 5 feet, while on the crests of the bars it is reduced to less than 1 foot. The rise of the tide being added, there is generally in each day for a short time a depth of 6 feet in the shoalest places. The arrival and departure of steamers and other vessels are necessarily timed in reference to passing the shoal places when the phase of the tide will permit, and vary from day to day.

It thus appears that the shoals are due to the action of freshets in bringing down gravel, while the navigable value of the river results from the constantly-recurring tide.

The gravel becomes quite compact in the bed of the channel. If it is moved in the rising phase of a freshet, it appears to be redeposited in the falling phase. The deposits are found sometimes in the narrowest sections of the channel, and form an obstruction to the influx of the tide. The tidal currents are ineffectual to their removal.

It is thought that dredging will be essential to give increased depth. Regulation of the channel by artificial constructions will hardly be effectual, and when increased depth is once obtained by dredging, it is not to be expected that the improvement will be permanent, but that dredging will be required periodically.

The width between banks at Napa City varies about a mean of 100 feet, increasing a few miles below to a wide tidal channel. The influence of the tide extends above Napa City. The mouth of the river is at the head of Mare Island Strait, which connects with San Francisco Bay.

The distance by water separating Napa City and San Francisco is about 40 miles.

Two steamers are employed in trade between these points, each making three trips per week. In addition, small sail vessels are employed as required, particularly in the autumn, when the agricultural products are moved. So far as can be learned, the principal freight route for Napa City and the immediate vicinity is by water. There is also railway communication.

Napa Valley is one of the richest portions of the State of California, and is noted for its vineyards, although other crops are cultivated. The valley contains two towns of importance, Napa City, situated at the head of navigation, and having several thousand inhabitants, and Saint Helena, a few miles above, is also a town of some importance. The soil and climate of Napa Valley are both highly esteemed, and its prosperity seems to be entirely assured.

Such statistics of freight by water as could be obtained accompany this report.

There are a few manufacturing industries at Napa City, the principal of which is of leather, and others of woolen goods and flour. The wine industry is predominant in the valley.

The obstructions to navigation, apart from shoals already mentioned, consist of snags brought down by freshets and distributed along the channel, and a special danger in the shape of a small reef of rock.

The removal of these obstructions comes within the limits of ordinary routine, and needs no special remark. There has been no complaint of shoal water in the part of the river unexamined, and no depth less than 4 feet is found by survey until we approach Napa City within 4 miles. The general depth in this part of the river is about 5 feet, increasing to 10 or 12 feet in the bights, and lessening to 2 feet or less on the shoals.

The steamers engaged in the trade of Napa City draw about 4 feet, and the sail vessels do not vary much from this draught, which is regulated by convenience in passing the shoalest places.

The length of channel with depth less than 2½ feet is 3,050 feet; less than 3 is 3,600 feet; less than 4 feet is 6,400 feet. A channel 50 feet wide on the bottom, 2½ feet depth, extended to the usual steamer landing, will require 6,500 cubic yards of dredging measured in place, and extended a quarter of a mile farther to the Vernon Mills, 1,500 cubic yards additional, or a total of 8,000 yards.

A 3-foot channel of the same dimensions will require 12,020 cubic yards.

A 3-foot channel 75 feet wide on bottom to the bridge, and 50 feet wide above, will require 16,997 cubic yards.

A 4-foot channel, 75 feet wide to the bridge, and 50 feet above, will require 35,700 cubic yards.

In alignment the channel is fairly convenient. There are, however, two bends, Jack's and Carr's bends, which are liable to cause some delay to vessels passing. The cost of making a new channel at the upper or Jack's bend is thought to be out of proportion to the advantage that would result. The case is different to some degree at Carr's bend. A better alignment can be made here by opening a new channel through a low point standing at about the level of high-water mark. A convenient channel 150 feet wide and 4 feet deep can be made by dredging 9,500 cubic yards.

Including this amount the total dredging required to give a good 3-foot channel is 26,500 cubic yards, and for a 4-foot channel 45,200 cubic yards.

Adding the rise of the tide the depth at high water will vary between 9 and 11 feet. This depth, if maintained, would, it is thought, afford all advantages that could be desired. It is not, however, probable that this depth will be maintained, owing to deposits left one or more times each year by freshets. It is to be expected that the present condition of the river bed will be reproduced in the course of a very few years.

Dredging will be more than ordinarily expensive, owing partly to the fact that the material is hard and compact, but particularly to the difficulty of disposing of it after it is dredged, either by putting it ashore or by discharging it in suitable places in the lower river several miles distant. The highly cultivated riparian lands prevent the application of hydraulic carriage, which has the merit of cheapness, but which necessarily floods the lands and distributes the material over them.

Placing dredging at 50 cents, the estimate becomes, for a 4-foot channel—

45,200 yards	$22,[illegible]
Removal of reef	[illegible]
Removal of snags	1,[illegible]
	24,[illegible]
Add 10 per cent	2,[illegible]
Total	27,[illegible]

Napa River is in the customs district of San Francisco.

Respectfully submitted.

G. H. MENDELL,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. L. J. LE CONTE, ASSISTANT ENGINEER.

SAN FRANCISCO, CAL., *January* 17, 1885.

SIR: I have the honor to submit the following report on the results obtained during the survey of Napa River, made under your direction.

The survey was commenced at a point near the Vernon Mills, a short distance above the present railroad crossing at Napa City. Thence the work proceeded down river to a point at the head of Bull Island, including a total distance of some 40,000 feet linear, or, say, 1.75 miles below the Suscol Ferry.

Three tide-gauges were in use for the hydrographic work—one at Napa City, one at the asylum wharf, and the third at the wharf at Suscol Ferry.

The zero marks of each gauge were connected with suitable bench-marks established near by, and the whole system connected by a line of levels carried down river along the east bank.

The low water adopted for the reduction of soundings on this survey was taken or assumed at an elevation of 1.7 feet below the low-water reading observed on the Napa City gauge on the evening of December 11. This low water, by estimation from the Oakland Harbor gauge reading of that date and time, reduced to the Coast Survey low water, was 1.50 feet above low water. Also, since the low-water tidal constant for Mare Island is = + 0.2 it follows that the predicted low-water elevation at mouth of Napa River was at that time 1.7 feet above Coast Survey low water.

In setting the gauge at Napa City it just so happened that the low-water reading of December 11 was found to be also 1.7 feet, hence the zero of this gauge was adopted as low water for Napa City and vicinity.

By the gauge at the asylum wharf it was ascertained that the corresponding low water was 0.08 foot below that at Napa City, and, lastly, it was also ascertained that the same plane at Suscol Ferry gauge was 0.30 feet below that at Napa City.

Wing-dams.—As regards the possibility of improving the navigable channel by constructions, I would state that as far as my observations extended I saw no place where artificial construction could be applied with any marked advantage. The river channel as a rule is narrow and the banks quite bluff, and where shoal-water bars do exist, there seems to be no corresponding increase in width between adjoining high-water banks.

Dredging work.—There seems to be little or no question about the fact that the most feasible and effective plan of alleviating the present needs of navigation is by dredging out channel-ways through the shoal-water bars, the material of which is mostly coarse gravel and sand. The easiest and best place to deposit the excavated material would be on the adjoining banks. In regard to obtaining permission of land owners for the right to such disposal, I would state that the matter has been taken in charge by the city attorney of Napa, who will call a meeting of the riparian proprietors and discuss the entire subject, after which they will frame a document for general signature stating what they would be willing to do in the matter. This document will be forwarded to the office as soon as practicable.

Lone Tree Reef.—This obstruction was examined with care. It proves to be much more formidable than I had reason to expect from reports of the river men. In brief, the obstruction may be described as follows: The reef is due to the encroachment of a "spur" or low ridge coming down from the foot-hills on the east. The difficulty here consists in a dangerous shoal-water bench, which occurs in the middle of the bend and along the concave bank. This bench projects out in places 60 feet from low-water line and is covered 1 to 2 feet of water at low tide; thence across to the westerly bank the depths are generally ample for all present or future needs of navigation. This submerged bluff bank extends up and down stream a distance of about 300 feet, and is therefore a formidable obstruction to remove. The material of this reef is argillo, calcareous sandstone, considerably disintegrated. A sample is herewith submitted. While the examination was going on a new discovery was made in the form of a point of rocks, located in the channel next to the point, which is now being used for navigation. These points of rocks or "stumps," so called from their similarity in form, were found to exist at a point distant about 50 feet from the west bank. There was a depth of only 1.5 to 2 feet at low water on top of these stumps, while immediately around it there was fully 6 feet water at the same stage of tide.

As to the question of improving this reef, I am of the opinion that the only practicable way to do so would be to simply remove the points of rocks by surface blasting, and thus clear the point channel now in use. Sailing vessels have frequently hit these "stumps" and carried away their rudders.

Snags.—The low tides in Napa River did not occur at times which permitted me to thoroughly examine the channel with the view of counting the number of snags in the way of free and safe navigation. By combining those which I did see with those noted on the river charts by the pilots, I was enabled to enumerate about thirty snags and hanging trees. Their approximate position is shown on the accompanying river chart used during the examinational survey.

Jack's Bend.—This is a sharp bend, with narrow channel-way, distant about three-quarters of a mile below Napa City. The proposition to make a cut-off at this place is impracticable. The land on the point is all improved property and cannot be obtained at a reasonable price. I do not think it feasible to do anything here which will be of any assistance to navigation in this connection.

Carr's Bend.—This is the first sharp bend above Lone Tree Bend. The high land on the point is cultivated land up to within 350 feet of the point. This 350 feet next the point is low-tide land mostly, subject to overflow at high tide. This portion is newly-made land, and of little or no present value. The steamers have trouble in rounding this bend, particularly when sailing vessels happen to meet them at this place. It is possible that temporary relief may be obtained here by cutting off the tule point. This work would involve the excavation and removal of some 9,500 cubic yards of material.

In conclusion, I would state that a pile structure, offering considerable obstruction to navigation, is reported to exist near the mouth of Napa River; it is the site of an old railroad bridge.

The center pier should be removed. Commercial statistics for Napa City are herewith inclosed.

Very respectfully, &c.,

L. J. LE CONTE, C. E.,
Assistant Engineer.

Col. G. H. MENDELL,
Corps of Engineers, U. S. A.

ESTIMATE OF THE YEARLY COMMERCE OF NAPA RIVER, FURNISHED BY W. H. WULFF, OF NAPA CITY.

Two steamers (the Caroline and Emma) discharge at the Napa wharves, freight	tons..	20,800
Coal received from schooners	do...	5,000
Hay shipped by vessels	do...	2,000
Leather and wool shipments	do...	400
Glue shipments	do...	20
Sand received	do...	1,500
Lime and cement received	do...	500
Grain shipments by the different flouring-mills	do...	3,000
Lumber received	feet..	10,000,000
Brick received	number..	600,000
Tan-bark received	cords..	1,000
Wine shipped	gallons..	1,500,000
Miscellaneous, consisting of fruit, produce, and general freight	tons..	2,000

APPENDIX Q Q.

IMPROVEMENT OF THE HARBOR AT SAN DIEGO, CALIFORNIA.

REPORT OF COLONEL C. SEAFORTH STEWART, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

SAN FRANCISCO, CAL., *July* 8, 1885.

SIR: I have the honor to forward herewith the annual report for the year ending June 30, 1885, of the river and harbor work in my charge.

Very respectfully, your obedient servant,

C. SEAFORTH STEWART,
Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

IMPROVEMENT OF THE HARBOR AT SAN DIEGO, CALIFORNIA.

No repairs were made to the levee in 1884, on account of the high stage of the San Diego River, due to the unprecedented rainfall and floods of the winter 1883–'84. The water continued to flow throughout the latter year, an unusual thing, not sinking until the present summer.

The rainfall for this fiscal year has been 8.65 inches, nearly the average. Of this amount all but 3 inches fell before January. In that month the damage to the embankment of the levee and to its stone facing caused, during the two past years, by the wash of surface water, by the burrowing of badgers, and by cattle following trails which lead across the work to water and to pasturage, has been made good. The cost of work done has been $78.

With the exception of some slight injury since January, due to cattle and badgers, the levee is in good condition.

FINANCIAL STATEMENT.

Appropriated by act approved March 3, 1875	$80,000 00
Expended to June 30, 1879	80,000 00
Appropriated by act approved March 3, 1879	1,000 00
Expended to June 30, 1885	450 50
Available July 1, 1885	549 50

This work is in the collection district of San Diego. That town is the nearest p of entry. Point Loma Light is the nearest light-house. The nearest fort is that gun at Ballast Point. The amount of revenue collected at San Diego during the fis year ending June 30,1885, is reported as $5,741.49.

Money statement.

July 1, 1884, amount available	$627 2
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	78 [illegible]
July 1, 1885, amount available	549 2

APPENDIX R R.

IMPROVEMENT OF ENTRANCE TO HUMBOLDT BAY; OF SAN JOAQUIN, MOKELUMNE, SACRAMENTO, AND FEATHER RIVERS, CALIFORNIA, AND OF COLORADO RIVER, NEVADA, CALIFORNIA, AND ARIZONA.

REPORT OF CAPTAIN A. H. PAYSON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Humboldt Bay, California.
2. San Joaquin River, California.
3. Mokelumne River, California.
4. Sacramento and Feather rivers, California.
5. Colorado River, Nevada, California, and Arizona.

EXAMINATION.

6. Yuba River, California.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 14, 1885.

GENERAL: I have the honor to transmit the annual reports of the river and harbor works under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

A. H. PAYSON,
Captain of Engineers

The CHIEF OF ENGINEERS, U. S. A.

R R 1.

IMPROVEMENT OF HUMBOLDT BAY AND HARBOR, CALIFORNIA.

The work proposed with funds available and asked for is the construction of a low wall upon the south sands to fix the shifting bar channel in accordance with the plans of a Board of Engineers, dated October 13, 1882.

In addition to this training-wall, protective measures for the end of the north spit may become necessary.

The work is one of great difficulty and exposure, and if carried on with small annual appropriations will certainly be much more costly in the end and very possibly result each year in the destruction of what has been before accomplished. With this view nothing has been done toward construction with the sum available at the beginning of the year.

It would have been hardly more than sufficient for the establishment of the necessary wharf, buildings, track, and miscellaneous plant on the South Spit, and it was not thought best to make these preparations before the necessity for them had arisen.

Before work is begun it will be necessary for the Government to secure about twelve acres of land which is owned in undivided interest by six persons, while the water front, which is also needed, is held by a corporation. I have not yet been able to get definite offers for sale to the United States from all these parties, but am able to state that the land alone cannot be had for less than from $9,000 to $12,000. As it is quite worthless, save from the presumed necessities of the Government, I reported these facts to the Department in a letter dated April 7, 1885, asking permission to take the initial steps for a suit in condemnation. In reply the Department informed me, under date of April 22, that the existing appropriation was not under the law available for the expenses of such a suit. This is unfortunate, for as soon as the funds available for the work are sufficient to warrant its commencement, we shall be confronted with the alternation of yielding to the exorbitant demands of the land-owners or the loss of another season through the legal delays of condemnation.

The bar channel, which was in its northerly position during June, 1884, but very narrow, gradually closed during July with the simultaneous development of a south channel. The latter part of August the north channel became impracticable, and the south channel continued improving until November, when a survey made by the Coast Survey steamer McArthur showed it nearly straight out west, and with excellent water. During December and January this western channel widened out to an extensive flat, with but little water anywhere; and this state of affairs gave rise to much inconvenience and delay. In February or March, 1885, an extreme south channel broke out (south by west) and has since remained in that position very shoal and crooked. There is now a northern channel forming (west by north), but it has 1½ feet less water than the southern, and is but little used. Owing to the very bad condition of the bar since February the foreign trade in lumber was almost suspended. Vessels in port and loaded were obliged to discharge parts of their cargoes and proceed elsewhere to finish loading.

Total amount so far appropriated is	$142,500 00
Total amount expended is	80,027 [illegible]

Money statement.

July 1, 1884, amount available	$81 [illegible]
Amount appropriated by act approved July 5, 1884	62,500 00
	62,581 [illegible]
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	109 [illegible]
July 1, 1885, amount available	62,472 [illegible]
Amount (estimated) required for completion of existing project	537,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	200,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

STATISTICS FURNISHED FOR THE YEAR ENDING JUNE 30, 1885, BY THE COLLECTOR OF CUSTOMS AT EUREKA, AND BY AGENTS OF STEAMERS PLYING TO HUMBOLDT BAY.

Exports of lumber in 335 vessels, as follows:

Dressed lumber	feet..	69,588,570
Shingles	number..	41,972,950
Shakes	do...	1,669,300
Posts	do...	6,700
Tan bark	cords..	270

Of these 335 vessels, 28 cleared foreign with cargoes valued at $201,500.

There were thirteen entries from foreign ports.

There are two steamers a week from San Francisco to Humboldt Bay. One of these carried during the year—

To Humboldt Bay:

Freight	tons..	5,949.9
Passengers		4,109
Treasure		$127,760

From Humboldt Bay:

Freight	tons..	13,528
Passengers		4,195
Treasure		$170,847

The business of the other steamer was probably somewhat less, though her agents failed on application to give any information.

R R 2.

IMPROVEMENT OF SAN JOAQUIN RIVER, CALIFORNIA, INCLUDING STOCKTON AND MORMON SLOUGHS.

Reference is made to the detailed report of Assistant Engineer W. P. Smith.

The contractor for the Devil's Elbow cut-off having failed, a new contract was let July 21, 1884, with Thomas H. Williams, jr., at 15 cents per cubic yard.

Work began August 10, 1884, and finished October 10, with the removal and deposit ashore of 24,519 cubic yards of stiff clay.

The machine was an endless chain dredge of fine construction, great size and power, but the nature of the material gave much trouble and rendered progress slow.

The channel formed is 100 feet wide at bottom, 10 feet deep at low water, and 900 feet long on the center line.

The lower approach was for some time obstructed by the sunken dredge belonging to the failing contractors of last year.

Several attempts on their partfor its removal having failed the snag-boat was sent to the cut in January, 1885, and in three days' working time broke up and completely removed the obstacle.

The cut-off is a great convenience to navigation, and as was the case with the similar cuts before made, the old channel very quickly closed.

On September 15 a contract was entered into with Messrs. Von Schmidt and McNee for dredging and deposit on shore in San Joaquin River, Stockton and Mormon Sloughs at the price of 17.47 cents per cubic yard.

The machine used was the pump dredge which has accomplished such excellent work in Oakland Harbor, and the distance at which the material was deposited reached in some cases 2,000 feet.

The material varied from clear sand to mud, and the total quantity removed was 134,411 cubic yards, as follows:

In Stockton Slough a channel was cut 5,250 feet long, varying in width from 60 feet to 110 feet, and to the depth of 9 feet at low water. Quantity removed, 60,786 cubic yards.

In Mormon Slough the dredging was 60 feet wide by 4,250 long, and a a depth of 6 feet at low water. Quantity removed, 47,595 cubic yards.

At the mouth of Stockton Slough the cut was 80 feet wide, 700 feet long, and 9 feet deep at low water. Quantity removed, 12,908 cubic yards.

On the narrows of the San Joaquin the cut was 1,050 feet long, [illegible] feet wide, and 9 feet deep at low water. Quantity removed, 13,122 cubic yards.

The dredge showed itself admirably adapted for work in any mixture of mud and sand, while the bottom left by its operation was almost perfectly regular.

Ten years ago, 69 cents a yard was paid for the class of work in which the adoption of the pump dredge now enables the contractor to make a large profit at 17.49 cents.

As has been before explained, the natural scour in the important channel below Stockton depending on some 2 feet of tide cannot, by any engineering device be made equal to the removal of the deposits. Dredging is the only effectual relief and its suspension for a single season will cause serious inconvenience.

A hasty examination of the ground dredged over last autumn, was made in April, 1885, from which the deposits within the limits of the cuts has been estimated as follows:

	Cubic yards
In Stockton Slough	30,[illegible]
In Mormon Slough	9,000
In Narrows	6,000

The barrier for impounding deposit built two years ago by the Government just above the head of navigation in Mormon Slough, has held back over 200,000 yards of material; much of which would have gone into the navigable channels of Stockton and Mormon sloughs.

The expectation that much of this material would be removed by the city and private parties for filling lots has not been fulfilled, and the storage space being full the present dam is of no further use.

Had there been the anticipated demand from the city of Stockton for material impounded by these barriers, there could be no more economical device for the assistance of the channels below; but failing this, I am not now prepared to recommend an extension of the system with the responsibility attached of cleaning out each year the spaces behind the dams and disposing in an unobjectionable way of the deposits.

OPERATION OF THE SNAG-BOAT SEIZER.

Besides the removal of the sunken dredge before mentioned, the snag-boat spent ten working days during May, 1885, in clearing the upper river of snags between the railroad bridge and Hill's Ferry.

This was very thoroughly accomplished in the removal of ninety-six snags and forty five trees, but unforeseen obstacles are always likely to arise in the critical period when the river is just becoming unnavigable and the business to be accommodated by it is at its maximum. Money should always be on hand to meet such cases, when the expenditure at the right moment of a small sum may secure very important benefits.

Each spring the snag-boat ought to spend ten days or two weeks in the upper river before the necessity has arisen for work on the Sacramento, after which an emergency can be met by special arrangement with the boats navigating the San Joaquin.

In accordance with these views the sums available and asked for are to be applied in dredging on the lower river, Stockton and Mormon Sloughs, and to such snagging work and temporary regulation of the low-water channel as may become necessary on the main river above the mouth of Stockton Slough.

The aggregate of the appropriations made for this river, beginning August 14, 1876, is $140,000, of which there has been expended $139,446.40.

This river is in the customs district of San Francisco, at which port there was collected $6,610,807.68 in the past fiscal year.

Money statement.

July 1, 1884, amount available	$10,997 37
Amount appropriated by act approved July 5, 1884	20,000 00
	30,997 37
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	30,443 77
July 1, 1885, amount available	553 60
Amount that can be profitably expended in fiscal year ending June 30, 1887	40,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of bid for dredging cut-off at Devil's Elbow, San Joaquin River California, received and opened by Lieut. Col. George H. Mendell, Corps, of Engineers, 12 m., July 8, 1884.

Name of bidder.	Price per cubic yard.
	Cents.
Thomas H. Williams, jr	15

Contract awarded to Thomas H. Williams, jr., July 21, 1884.

Abstract of bids for dredging Stockton Slough, Mormon Slough, and San Joaquin River, California, received and opened by Capt. A. H. Payson, Corps of Engineers, 12 m., September 8, 1884.

No.	Names of bidders.	Price per cubic yard.
		Cents.
1	Von Schmidt & McNee	17.49
2	Thomas H. Williams, jr	22½
3	Edgar W. Emerson	25

Contract awarded to Von Schimdt & McNee September 15, 1884.

REPORT OF MR. WILLIAM P. SMITH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
San Pedro, Cal., *May* 20, 18[illegible]

SIR: I have the honor to submit the following report made on improvements on the San Joaquin River, including Stockton and Mormon sloughs, during the past fiscal year, and with which I was connected as assistant engineer.

UPPER SAN JOAQUIN RIVER.

On what is known as the Upper San Joaquin, which is that portion above the city of Stockton, no improvements have been made during the year. Two examinations were made by yourself—one of Paradise Crevasse, 2 miles above the railroad bridge on September 30, and one in the vicinity of the town of Grayson October 3.

LOWER SAN JOAQUIN RIVER.

The city of Stockton is situated on a slough of the same name 2½ miles from its entrance into the San Joaquin River. For about 4 miles from this junction down-stream it is termed the "Narrows." In this portion of the river the two improvements were made. The new channel or cut-off through what is known as the Devil's Elbow, commenced during the last year, was completed, and a shallow reach above it was dredged.

CUT-OFF AT DEVIL'S ELBOW.

The contract for making this new channel of the river was let in August, 18[illegible]. The contractor, after about half completing it or after excavating to about half the required depth, encountered a stiff clay, which his machine was unable to dredge. Several extensions of time were given him, but the contract was finally taken from him on May 15, 1884, and on July 21, 1885, was relet to Thomas H. Williams, jr., at 15 cents per cubic yard. The first contract was for 16 cents per cubic yard, and the contractor excavated 23,594 cubic yards. He was paid for 23,146 cubic yards, less 10 per cent. Work was commenced on the new contract August 10, 1884, and the cut completed October, 1884. The amount of material taken out 24,519 cubic yards. A levee was built on the inside of the cut with the dredged material. The new channel was made 100 feet wide at the bottom, and the sides left as formed by the dredge makes the width at low-water level 124 feet. It is 10 feet deep at low water and the length on the center line is 900 feet. The cut was obstructed for a time near the lower approach by the dredge belonging to the first contractor sinking near the left bank. It was removed by the United States snag-boat Seizer in December. The Devel's Elbow was considered the worst bend on the lower river. The old channel is fast filling up, and the new one is used by all, and fully appreciated by both steamers and sailing vessels.

DREDGING IN THE NARROWS.

Above the Devil's Elbow, and a short distance below Stockton Slough, we find each year a deposit of clean white sand, which is brought down the San Joaquin River during high water. The shoal is generally about 2,000 feet in length, and at low water and low tide there was less than 5 feet of water before dredging was commenced.

The rise and fall of the tide is about 2 feet during the low water season. This same reach of the river was dredged once before. The portion dredged this year was 1,650 feet in length, 60 feet wide at the bottom, and to a depth of 9 feet at low water. Thirteen thousand one hundred and twenty-two cubic yards of sand was dredged and deposited on the bank. The cut began filling at once with the sand that is constantly moving down the river, but no further trouble was experienced during the season. It is probable, however, that next year shoal water will be found at the same place. At the outlet of Stockton Slough on its turn into the Narrows a bar had formed of a mixture of sand coming down the river and earthy sediment coming down the slough. This was taken out, necessitating dredging a channel 700 feet long an average width of 80 feet and to 9 feet at low water. The amount of material taken out at this place was 12,908 cubic yards. This cut has maintained its width and depth the last I heard from it, and had saved the steamers much annoyance and delay in making the turn in and out of the river.

STOCKTON SLOUGH.

That portion of this slough between the outlet of Mormon Slough and the river, a distance of about 7,000, feet is filled up each year by the sediment coming down Mormon Slough to an extent that makes navigation very troublesome, and compels vessels to often wait for the 2 feet rise in the tide. About the same depth of water was found here this year before dredging as existed in the Narrows, but the slough being wide, with sloping banks on both sides, it is more difficult to keep the channel narrow at its best. Five thousand two hundred and fifty feet in length was dredged to 9 feet at low water; 2,950 feet had a width of 60 feet, and 2,300 feet a width of 110 feet. Amount of material dredged and put ashore was 60,786 cubic yards.

MORMON SLOUGH.

This slough, which is navigable at high water about 10,000 feet from its mouth, had at low water of this season a practicable channel of less than 3 feet in depth. The lower half had in places over 4 feet, but the upper portion less than 2 feet. It was not practicable with the funds available to dredge the entire length. The dredge that was used drew 4 feet. Nothing was done when it would float freely at low tide. When the channel was dredged it was made 60 feet wide and 6 feet deep at low water. Four thousand two hundred and fifty feet in length was excavated to these dimensions, requiring the dredging of 47,595 cubic yards of soft sediment and sand.

In the Narrows in Stockton and Mormon sloughs the work was done by the Von Schmidt pump-dredge, and the material carried in some cases 2,000 feet. The channel was made of very uniform dimensions, and the material distributed on shore in such a manner as to leave no possibility of its return to the channel. Less than ten years ago 69 cents per yard was paid for this class of work. The contract was let this year for 17.49 cents per cubic yard.

Two years ago the United States constructed a restraining barrier on Mormon Slough, about 200 feet above the head of navigation. It was understood that the city authorities would excavate each year the material collected by it. The city also built a similar and smaller one some 2,000 feet above. There has collected behind these two barriers, in two years, over 200,000 cubic yards of sediment, much of which would have been carried into the channels of Mormon and Stockton sloughs below. A small portion of this has been removed each summer by teams, but it is so little that it gives poor encouragement to raise them or construct others.

The barriers have done their work, and are, of course, now useless. It is suggested that a portion of the next appropriation for Mormon Slough be expended in clearing out behind the lower barrier.

Three sheets accompany this report showing the area dredged over, and the condition before and after dredging of the narrows of Stockton Slough and Mormon Slough.

Respectfully submitted.

Wm. P. Smith,
Assistant Engineer.

Capt. A. H. Payson,
Corps of Engineers, U. S. A.

Estimate of exports and imports of the city of Stockton for the year ending June 30, 1885.

EXPORTS.

	Tons.
Wheat, barley, and cereals	95,000
Flour and mill stuff	66,800
Vegetables, potatoes, onions, &c	25,000
Fruit, grapes, &c	7,500
Carriages, furniture, agricultural machinery, &c	750
Paper	1,200
Leather	1,000
Wine and brandy	750
Hides, pelts, and glue stock	500
Miscellaneous freight	15,000
Total	213,500

IMPORTS.

	Tons.
Agricultural implements	5,000
Machinery, iron, and hardware	30,000
Paper stock, chemicals, &c	1,100
Hardwood lumber	2,000

	T[illegible]
Building and fencing lumber	15[illegible]
Coal	[illegible]
Lime and cement	1[illegible]
Tan bark	[illegible]
Miscellaneous freight	5[illegible]
Total	2[illegible]

Estimate of trade by steamers and barges upon the Upper San Joaquin for the year [illegible] *June 30, 1885.*

DOWN FREIGHT.

	T[illegible]
Wheat, to San Francisco	[illegible]
Wheat, to Stockton	15[illegible]
Hay, vegetables, &c	[illegible]
Wood to Stockton	[illegible]
Wool to Stockton	[illegible]
Wool to San Francisco	[illegible]
Total	101,[illegible]

UP FREIGHT.

	T[illegible]
Lumber from San Francisco	3[illegible]
Lumber from Stockton	6,[illegible]
Miscellaneous freight from San Francisco	25[illegible]
Miscellaneous freight from Stockton	5,[illegible]
Total	6[illegible]

R R 3.

IMPROVEMENT OF MOKELUMNE RIVER, CALIFORNIA.

An appropriation of $8,500 was made by the act of July 5, 1884.

The report of an examination by Lieut. S. W. Roessler, in Octob 1884, with recommendations for the expenditure of this money, is her with.

The Mokelumne is only navigable in its tidal part, which exten some 22 miles above the point where it empties in the San Joaq River. Of this distance rather more than half has sufficient water and offers no obstruction, save that arising from the narrowness of the strea itself; the remainder has still enough water, but is obstructed with snags, while the heavy growth on the banks is a cause of much damage to passing boats, taking, as these do, the entire width of the river.

The snag-boat accordingly received orders in November to clear a practicable and reasonably safe channel from Snodgrass Slough, where the obstructions began, to Benson's Ferry, the head of navigation, a distance of about 10 miles. These instructions were carried out betwee November 1 and December 8, 1884, by the removal of 160 snags and 314 overhanging trees.

The concave banks were also partially cleared. Though now navig able, by the steamers used, to Benson's Ferry, a good deal of snagging and clearing could still be done with advantage, and to these purpose it is proposed to devote the funds available and asked for.

Total amount appropriated	$8,500 00
Total amount expended	4,958 00

Money statement.

Amount appropriated by act approved July 5, 1884	$8,500 00
July 1, 1885, amount expended during fiscal year	4,958 09
July 1, 1885, amount available	3,541 91
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	5,000 00

REPORT OF LIEUTENANT S. W. ROESSLER, CORPS OF ENGINEERS.

SAN FRANCISCO, CAL., *October* 21, 1884.

SIR: I have the honor to report the results of my examination of the Mokelumne River, made by your verbal instructions, October 18.

The Mokelumne empties into the San Joaquin 20 miles above the latter's junction with the Sacramento, and for a distance of 22 miles above its mouth is a tidal stream with a narrow and crooked channel but ample depth of water. At a point 15 miles above the mouth the river divides into two branches, the North and South Forks, which join 9 miles below, forming Staten Island. The North Fork is the channel. New Hope Landing, situated at the head of the island, is the present head of low-water steamboat navigation. The steamboat Constance, of the California Transportation Company, of 265 tons capacity and 5 feet draught, plies between this point and San Francisco from once to thrice weekly throughout the year. It is the principal landing of the boat, and furnishes an outlet for a large section of country to the southeast. From the mouth to Snodgrass Slough, which empties into the North Fork 1½ miles below New Hope Landing, the river's course lies through tulle lands and offers no obstructions to navigation except those presented by the narrowness and crookedness of the channel. From Snodgrass to New Hope the banks are wooded, and snags and overhanging trees form the obstructions; a sand-bar across the fork at its upper end, giving 3 feet at low tide, obliges the steamboat to make the landing at medium or high stages of the tide, which here has a range of 4½ feet.

No complaints were made that this bar formed an obstruction, as the steamboat can easily regulate its movements below so as to reach this point at a favorable time. The next landing is Benson's Ferry, 7 miles above New Hope Landing. The present trade to Benson's is carried on by small sloops and schooners, and consists principally in the transportation of bricks from a large brick-yard located just above the ferry. But little grain goes down from this point. The steamboat has occasionally gone this far at very high water, but only when strongly pressed to do so, owing to the injuries the boat has to sustain by striking against projecting trees and branches. The opening of steamboat navigation to Benson's would supply cheap transportation to a large section of country to the northward, whose outlet is now by rail.

The reach between New Hope and Benson's is from 70 to 80 feet wide between banks, which are covered by trees and a dense growth of brush-wood, principally alder. Overhanging trees and snags form the obstructions. I found at no point a less depth than 6 feet at low tide, except at the ferry, where the depth was 4 feet. The tidal range here is about 2½ feet, and vessels drawing 5 feet can make the landing close to the brickyard.

Beyond Benson's the tide rapidly decreases in height, and the river becomes narrower, shoaler, and more crooked, making navigation impossible.

To make the river navigable between New Hope Landing and Benson's Ferry there will have to be removed in the neighborhood of seventy-five trees and sixty-five snags and the banks be cleared of brush-wood where the steamboats would rub in making the bends, in all about 7 miles of brush-wood.

It is recommended that the snag-boat commence work in the North Fork opposite Snodgrass Slough, removing overhanging trees and snags, and clearing the banks of brush-wood as far up as Benson's Ferry. The work will be slow, owing to the narrowness of the channel and the consequent necessity of using a landing-tackle to haul the snags and trees well up on the banks, where the boats cannot touch them as they rub along the bank. The trees which spring from the edge of the bank should be dug up with their roots so as to leave no stump against which the boat might strike.

Owing to the slackness of the current the snags do not show themselves by any ripple on the surface, and the water is too muddy to enable one to see them. Mr. Hansen, at New Hope, is familiar with their location, and it is suggested, to avoid loss of time hunting for them, that the engineer in charge of the snag-boat be authorized to employ him for a day to go over the reach and point out where they are.

There is no fuel to be had along the river, and it will be necessary for the sna to bring her barge. The barge can be left at the mouth of Georgiana Slough.

The South Fork of the Mokelumne affords a good channel to within a mile of i head. The upper end for the distance of 1 mile is full of snags, very narrow, and ve crooked. The width in places does not exceed 60 feet.

It was suggested to clear it of snags so as to enable the boats to approach New Ho Landing and depart by either branch. The width, however, is not believed to be su ficient to make this branch at all practicable at its upper end.

No work is therefore suggested for this point.

Very respectfully, your obedient servant,

S. W. ROESSLER,
First Lieutenant of Engineers.

Capt. A. H. PAYSON,
Corps of Engineers.

STATISTICS FURNISHED BY THE CALIFORNIA TRANSPORTATION COMPANY.

	To
Merchandise and produce	26,5
Grain	15,
Total	42,

Besides the above, some 2,000 tons of grain and a large quantity of brick and lu were carried in sailing vessels.

R R 4.

IMPROVEMENT OF SACRAMENTO AND FEATHER RIVERS, CALIFOR

Reference is made to the accompanying report of Mr. A. Boschke fo details of the snag-boat's operation during the year.

The *Seizer* was in commission on the Sacramento and Feather rivers one hundred and forty-eight days, of which ninety-nine days were o the former stream. Seven hundred and sixty-four snags and 41 trees were removed on the Sacramento. Five days were spent in scraping Fremont Bend and Salmon Bend, and thirteen days in the extensio and strengthening of the existing dams at Parrott's Chute and Cal Bend.

At my request the railroad company removed the superstructure o the unused bridge at Knight's Landing, and its pier, which had formed a bad obstruction, was removed by the snag boat.

On the Feather River 302 snags and 298 trees were removed and destroyed, and fifteen days were spent in building temporary dams to assist in the formation of a low-water channel. The assistant engineer in charge reports a significant change in the character of the bars in the Feather River, on which the presence this year for the first time of sand and gravel indicates the progressive influence of the débris from the hydraulic mines. During the winter's suspension of work the snag-boat was taken out of the water at Stockton for repairs. Every bit of bad timber was replaced by new, the hull received additional strength, the machinery, boiler, &c., were overhauled, repaired, and improved, and the boat went into commission in as good, if not better, order than when new.

During the season barges on the Sacramento were loaded as follows:

	Inches.
Head of navigation to Butte City	32
Butte City to Colusa	38
Colusa to Sacramento	54

Six inches added to these figures gives the ruling depth on the bars.

Navigation, with these draughts, was interrupted for a few days only at Fremont Bar and Salmon Bend, but quickly restored by the use of he scraper.

This is a slight improvement on the draughts reported for the precedng year, but the lowest water on the Sacramento gauge during 1884 was 6 inches higher than in 1883.

For the first time, it is believed, in the history of the navigation not an accident happened during the year to either barge or steamer, though more freight on deeper draughts was moved than ever before. For the important improvement which this indicates full credit is given to the snag-boat by the commerce interested.

There is reason to fear much trouble in the navigation of the Sacramento the coming season. The lack of snow last winter in the mountains threatens an unusually low stage, and the river is now, in the fore part of July, in about the same condition as during the lowest water of last year.

In explanation of the general plan for the improvement I quote from the annual report of last year:

> The absence of permanent banks capable of resisting the action of the river currents in freshets causes the channel in the river above Colusa to change position, not only from year to year, but often during the same season. If the river could be held between firm banks, permanent improvement would be possible, but the cost of establishing this condition of things is so great that the proposition cannot now be entertained.

It is proposed, therefore, to continue in future the policy of the past; that is, to maintain in commission during the greater part of the year a boat equipped to destroy snags, scrape bars, and build dams as the necessity arises; and it is proposed to continue these operations with the funds available and asked for.

The aggregate of the appropriations made for these rivers, beginning March 3, 1875, is $445,000, of which there has been expended, exclusive of outstanding liabilities, $221,750.53.

The Sacremento and Feather rivers are in the customs district of San Francisco, at which port there was collected $6,610,807.68 in the past fiscal year.

Money statement.

July 1, 1884, amount available		$210,036 66
Amount appropriated by act approved July 5, 1884		40,000 00
		250,036 66
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$26,787 19	
July 1, 1885, outstanding liabilities	2,738 12	
		29,525 31
July 1, 1885, amount available		220,511 35
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		40,000 00

REPORT OF MR. A. BOSCHKE, ASSISTANT ENGINEER.

UNITED STATES SNAG-BOAT SEIZER,
Feather River, June 30, 1885.

SIR: I have the honor to submit the following annual report on the operations of the snag-boat Seizer for the fiscal year July 1, 1884, to June 30, 1885. Its operations have extended during the year over the Sacramento, Feather, Mokelumne, and San Joaquin rivers.

The snag-boat has been at work during the fiscal year, 1884-'85, from July 21 until January 6, 1885, and from May 7, 1885, until June 30, 1885.

Under instructions of July 16, 1884, from Lieut. Col. G. H. Mendell, the snag-boat went into commission July 21, 1884, to clear the Sacramento River between Knight's Landing and the head of navigation, at Colby's Ferry, of obstructions dangerous to navigation.

The work had been assigned to the charge of First Lieut. S. W. Roessler, Corps of Engineers, and had progressed to free the river of its most dangerous obstructions as far as California Island by the 29th of July, when the charge of the boat was transferred to me.

By order of July 24, Lieut. Col. G. H. Mendell directed the boat to proceed to the Feather River to remove snags and overhanging trees obstructing navigation.

The low stage of the river prevented any extensive work. It extended from the mouth to Shanghai Bend, or within 3 miles of Marysville, the head of navigation. We removed one hundred and eleven snags from the river and eleven trees from the banks, when the rapidly falling river compelled us to leave on the 9th of August.

On the 10th of August the United States snag-boat Seizer and United States barge Aid, and all property belonging thereto, were transferred by Lieut. Col. G. H. Mendell to the charge of Capt. A. H. Payson, at the city of Sacramento, Cal.

Under instructions from Capt. A. H. Payson, August 10, the snag-boat and barge proceeded again up the Sacramento River to clear the channel of all dangers to navigation and improve the depth upon bars by building log wing-dams or deepen them by the use of the scraper.

The work was resumed under these instructions again at Knight's Landing. The snags from the river and trees from the banks were deposited out of the reach of the main currents, and there broken up in short pieces by blasting and chopping.

The work had progressed by the 1st of September to the head of navigation, leaving the channel free from the most dangerous snags. The next urgent demand to facilitate navigation was, on account of the falling river, to increase the depth at certain points. The log-dams at Parrott's Chute and at Call's Bend Bar were extended, when the necessity arose to deepen a bar at Salmon Bend, about 16 miles above Sacramento.

The snag-boat, under instructions of September 1, 1884, deepened the bar at Salmon Bend, by the use of the scraper, to 5 feet, over a distance of 500 feet by 80 feet wide.

Returned up river September 10, and on the way up worked at various points where the removal of obstructions would facilitate navigation or improve the free flow of the currents, thus preventing undesirable changes in the channel or cutting away of the banks, aiming in general to give the channel more stability.

At Call's Bend Bar and at Parrott's Chute work was resumed to strengthen the dams by filling in between the logs with fascines and sand-bags, making the dams practically tight and turning the strength of the current over the bars.

By the end of September shoal water was found below the point where the bar at Salmon Bend had been deepened by scraping, and navigation was restricted to a less depth than was available at all other points.

Under instructions of September 25, 1884, the snag boat returned to Salmon Bend and deepened the existing bar to 5 feet over a considerable distance, to a point where there were 13 feet of water. Completed this work October 10, 1884. After a few weeks the current increased the depth over the bar to 7 feet, which it maintained for the rest of the season.

Returned up the Sacramento River, and in passing Fremont Bar, we removed several shoal spots by scraping, obtaining least depth of 5 feet, which subsequently increased by natural scour to 8 feet.

Work of removing snags and trees and destroying them by blasting was carried on as we proceeded up the river.

Due regard was paid in the selection of obstructions to be removed to insure safety to navigation, widening and straightening the channel-way. During this trip we removed also a large number of snags which would be dangerous to navigation during the high-water stage of the river, when in many localities the course the steamers steer differs from the low-water navigation. By the end of October, 1884, the Sacramento River to the head of navigation at Colby's Ferry was cleared in a very satisfactory manner of obstructions.

During the entire season not an accident has occurred to either steamers or barges, which has never happened in former years—considering, further, that the barges now load to a greater draught than at any time previous, which fact speaks well for the efficient work the snag-boat is doing.

Under instructions dated October 21, 1884, the snag-boat returned to Sacramento City on the 3d of November, 1884, to proceed to the Mokelumne River to clear the North Fork of obstructions to navigation from New Hope Landing to Benson's Ferry.

This portion of the river is narrow and tortuous, obstructed by snags and overhanging trees, but it is susceptible to improvements which will make it a valuable water-course for commerce. Its low-water depth admits a draught of 5 feet for river and bay steamers.

Work was carried on under the above instructions from November 6 to December 4, 1884. Although we left the river in a navigable condition for river and bay steamers, much additional work remains to be done. We cleared only the concave bend of the river from overhanging trees and removed the most dangerous snags from the channel.

Time allotted for this work did not permit to make the improvement as complete as is desirable.

In time of flood the navigation of the North Fork is made difficult on account of the free discharge of the flood-water being obstructed at the mouth of Snodgrass Slough. The Cosumne River overflows near its confluence with the Mokelumne River, and discharges this body of water, under most unfavorable conditions, through Snodgrass Slough, again into the Mokelumne River below New Hope Landing. At this point the South Fork gave formerly relief to the flood-water, but the bed is now blocked by a mass of snags and trees for about 2 miles.

To remedy this unfavorable condition the South Fork should be cleared and the Cosumne River kept in its bed by closing some of its lateral sloughs.

The Mokelumne River, with its North and South Forks, would become a valuable commercial highway by these additional improvements.

Under instructions dated November 26, 1884, the *Seizer* proceeded up the Sacramento River, after completion of the work on the Mokelumne River, to Colby's Ferry, on a tour of inspection, in charge of First Lieut. S. W. Roessler, and returned to Knight's Landing December 19, 1884. On the way down the river considerable work was done in snagging at points determined upon on the up-river trip. At Call's Bend the river forms a narrow neck of about 1,900 feet in width, the distance along the river course being about 2¼ miles. An attempt was made by the owners of the adjacent land to make a cut through this neck by cutting a ditch, which if accomplished would probably have turned the entire river through this neck at the time of flood. Serious objections to such a radical change in the course of the river existed, and steps were inaugurated to prevent this action.

Rain set in on the 16th of December, 1884, and by the 26th the river rose 14 feet, making it impracticable to work at snagging. It had been determined to remove the old, for many years unused, railroad bridge at Knight's Landing, being a serious obstruction to navigation and the free discharge of the river's flood-water. Instructions issued on December 1 ordered as soon as practicable to assist the Central Pacific Railroad workmen in taking down the bridge, thus preventing the possibility of the wreck of the bridge to become an obstruction if it should fall into the river and be left there; also to pull the piles of the pier.

After the railroad workmen had disconnected the truss frames of the bridge, we took them down and secured them to the Knight's Landing shore, but could not pull the piles of the pier on account of the high stage of the river, the top of the piles being 2 feet below water.

We would at once have returned to Sacramento to lay up the boat for the season, but the current of the river at the Sacramento Railroad Bridge set obliquely through the draw with great velocity, making it impossible for any steamer to pass the draw with safety. This condition lasted until December 30, 1884, when it was safe to take the snag-boat, without the barge, through the draw. The barge was left in charge of a watchman at Knight's Landing. Under instructions of December 29, 1884, the snag-boat went to Stockton for repairs, and on the way took out the sunken dredge at the Devil's Elbow Cut-off.

On January 6, 1885, the snag-boat was hauled out, the hull and machinery cleaned, estimates for repairs prepared, and on February 4, 1885, Lieut. Col. G. H. Mendell held an inspection of the boat and machinery, after which the needed repairs were begun.

The hull and machinery were thoroughly repaired, at a cost of $5,525.19.

On April 21, 1885, the snag-boat was launched and got ready for this season's work.

Under instructions of April 23, 1885, the snag-boat left Stockton May 7, 1885, for the Upper San Joaquin River, to clear the channel, from the Stockton Slough to the head of navigation at Hill's Ferry, of snags, and the banks of overhanging trees.

The work was carried on in a thorough manner, and the river left in a condition free from dangers to navigation on May 18, 1885.

Under instructions dated May 11, 1885, the snag-boat proceeded on May 19 to the Feather River.

The barge Aid was ordered on May 11, 1885, to Sacramento, to undergo some repairs of calking her bulkheads and transoms; thence to proceed to San Francisco, to take on a load of coal, and join the snag-boat at Rio Vista, on its way from the San Joaquin to the Feather River. Work of snagging clearing the bank of overhanging trees and stumps, and building log-dams to confine the river current to scour narrow [illegible] the low-water stage of the [illegible]

[illegible] the work consisted of [illegible] These [illegible] and [illegible] the [illegible] of good [illegible] The [illegible] low-water stage the channel [illegible] of the water [illegible] The only means at our command [illegible] bars by building [illegible] these structures are temporary, but for the low-water [illegible]

[illegible] the bars are formed are of sand and fine gravel, and [illegible] the year, for the [illegible] If large quantities [illegible] which the river [illegible] sand prevails [illegible] We have built [illegible] dams, and [illegible] of the river for about 30 miles.

[illegible] that the work of improving the [illegible] a large body of loose material into [illegible] bars, and will require additional work [illegible] the said river.

Very respectfully,

A. B[illegible],
Assistant Engineer.

Summary of work by United States snag-boat Seizer, during fiscal year from July 1, 1884, to June 30, 1885.

Date.	Snags.	Trees.	Blasts.	Tonite pounds.	Miles run.	Remarks.
1884.						
July	67	.....	50	218	287	In the Sacramento River.
	6	....	......	....	11	In the Feather River.
August	1[illegible]5	11	21	186¾	[illegible]	Do.
	202	10	4	72	252	In the Sacramento River.
September	182	8	26	365¼	355	In the Sacramento River, building two dams and deepening Salmon Bar.
October	280	23	188	868	346	In the Sacramento River.
November	111	288	231	535¼	149	Mokelumne River.
December	49	82	69	242	129	Do.
	33	....	54	169	348	Sacramento River, removal of Knight's Landing Bridge and sunken dredge.
1885.						
January	.....	....	.....	...	.....	Repairs of snag-boat.
February	....	.....	......	......	....	Do.
March	....	...	.....	......	......	Repairs.
April		..	.....	......	......	Do.
May	96	45	39	89¼	187	San Joaquin River.
	93	58	59	168	156	Feather River.
June	93	229	158	1,053¼	282	In Feather River.

COMMERCIAL STATISTICS.

The following statistics of trade for the Sacramento are furnished by Messrs. Thomas Dyer and Albert Foster, of Sacramento:

SHIPMENTS DURING THE YEAR ENDING JULY 1, 1885.

	Tons.
San Francisco to Sacramento (merchandise)	12,500
San Francisco (lumber, 12,000,000 feet)	24,000
San Francisco (coal)	3,000

	Tons.
cramento to San Francisco (merchandise)	4,500
cramento to San Francisco (bricks)	54,000
n Francisco to Upper Sacramento River (merchandise)	12,000
n Francisco to Upper Sacramento River (lumber)	8,000
cramento to Upper Sacramento River (merchandise)	4,000
rom Upper Sacramento (wheat, barley, and flour)	121,634
rom Upper Sacramento (wool, broom-corn, and hay)	2,450
rom Upper Sacramento, (wood, 12,000 cords)	24,000
Total transported	270,084

Besides the above there is a considerable trade in fruit and vegetables on the lower ver of which no statistics can be obtained. Mr. Foster, assistant superintendent of e Central Pacific Company's boats, estimates the shipments of wheat and barley lone for the coming twelve months as follows:

n store, crop of 1884	11,732
stimated crop of 1885	123,504
Total	135,236

The following statistics of trade for year ending July 1, 1885, on the Feather, are urnished by Mr. W. T. Ellis, of Marysville:

rom Marysville and way landings to Sacramento, Vallejo, Port Costa, and San Francisco (wheat, woolen goods, hides, tallow, and general merchandise)	15,600
From San Francisco and other points to Marysville and way landings (coal, salt, lumber, and general merchandise)	7,800
Total tons	23,400

R R 5.

IMPROVEMENT OF COLORADO RIVER, NEVADA, CALIFORNIA, AND ARIZONA.

Reference is made to the accompanying reports of Lieut. S. W. Roessler, Corps of Engineers, and Mr. W. P. Smith, assistant engineer, for the details of the examinations of the river and the works based upon them. Four sketches of points on the river where work was done last season and is planned for next are also transmitted.

No project for this improvement had been approved prior to the appropriation of $25,000 by the act approved July 5, 1884. An examination of the river made during the winter of 1878–'79 had indicated that the only effective application of the small sum available would be found in that portion lying between Camp Mojave and El Dorado Cañon, where it is almost entirely within high and permanent banks, and where the obstructions are chiefly bowlders and nearly stationary bars of cobble and gravel. Navigation in this stretch of the river is only possible from three to four months in the year.

Of the 285 miles on the river between Yuma and Camp Mojave perhaps 100 are in the Vicacho, Aubrey, and Mojave cañons, where the banks are permanent and the navigation good enough, as it is at all seasons of the year.

This leaves some 200 miles in which the stream presents in an exaggerated way the obstructions incident to its own enormous fluctuation in volume and a bed of very unstable materials. No point in this distance can be selected as continuously offering more of an obstacle than another, or at which a permanent improvement could be effected without the control and modification of the whole.

The expense of such an effort places it out of the question for the present, in view of the scanty trade to be accommodated, and the fact that river boats now can reach Camp Mojave at all seasons without very serious difficulty.

Accordingly the examination made during September, 1884, by Lieutenant Roessler for the collection of information on which to base a definite plan of work was limited to the distance between Camp Mojave and El Dorado Cañon.

This examination indicated those points at which there were hopes of permanent benefit with the means available, but the unusually high stage of the river prevented the collection of data precise enough for preparation of definite projects. The survey showed, however, that the worst obstacles had remained identical in position and nearly the same in form since 1879. A project based on the general plans of Lieutenant Roessler for improvement at Hatteras Bar, Six Mile Rapid, and Mojave Crossing was submitted to the Department October 13, with recommendation that hired labor instead of contract should be employed in view of the tentative nature of the works proposed and the unsettled country in which they were to be carried on.

This plan and recommendation having been approved by the Department's letter of October 30, a barge 100 feet long by 26 feet beam was built in sections in San Francisco, taken by rail to the Needles, put together, and launched there by a force of mechanics sent from here for the purpose.

The barge was provided with derrick and steam-capstan and fitted with quarters for the small force of white men which was to be employed.

With tools, provisions for thirty men three months, and miscellaneous outfit on board, the barge drew 9 inches.

We were fortunate in securing the service as foreman and pilot of J. A. Mellon, who had been master of steamers on the Colorado for seventeen years; was the only person familiar with its upper navigation, and peculiarly fitted by experience for the difficult management of the Indians, who were the only available labor. The barge was ready January 8, but wasted the time till January 26 in daily expectation of a river steamer which had been promised to leave Yuma January 1, but did not do so until the 10th.

Leaving the Needles January 26, the barge was towed by the steamer to Mojave Crossing by January 28, and thence by the aid of her own steam-capstan was hauled up stream 35 miles further to El Dorado Cañon in about six days' working time. An examination here showed the need for a dam some 700 feet long, and it was judged inexpedient to attempt it in view of the short working season remaining and the more imperative need for work at Six Mile Rapid. At that point a reef of bowlders some 200 feet wide stretches diagonally across the channel, entirely barring it at low water while during high stages the contracted water-way caused so violent a current that hauling over is difficult and dangerous. The improvement effected was the clearing of a channel, 150 feet wide and 1.5 feet deep at lowest water, of the bowlders; the enlargement of the high-water channel by clearing one of the contracting points of bowlders and cobble for a width of 60 feet and depth of 3 feet, and the building of a cobble dam 150 feet long below the rapid to lessen the high-water grade.

Twenty-five days were consumed in these works, during which thirty-six bowlders, from 1 to 12 tons weight, were removed below water, level, and 308 tons of bowlders and cobble were blasted and removed from the dry point.

A letter received in May from the captain of the steamer Gila reports that the clearing of the bowlders in the low-water channel saved the steamer Gila from total loss during her first trip up river this season.

On March 3 the barge dropped down from Six Mile Rapid to Mojave Crossing, 28 miles. The river here divides into two channels, and it was decided to close the western one, through which about one-third of the river was passing at the stage of 2 feet 6 inches above low-water. This work consumed eleven days, during which a cobble dam was built 464 feet long, 20 feet wide at base, and 5 feet high for half its length, the rest from 2 feet to 5 feet high. About 900 tons of stone were used, and the immediate effect was to raise the water in the open channel six-tenths of a foot and lower the closed channel, 500 feet below the dam, 2.4 feet. It is hoped that after next high water the west channel will close completely.

On March 18 the barge hauled up to Bowlder Rapid, 1½ miles above Mojave Crossing, and spent eight days in widening the high-water channel, removing 550 tons of stone from the right-hand point, lowering it 2 feet for a width of 100 feet. Two parallel ditches, 4 feet wide and 3 deep, were cut across the excavation to facilitate scour during next high water.

The river was now 4 feet above low water and rising rapidly, so on March 26 the barge was dropped down to Hardysville (12 miles above Camp Mojave), secured for the season, and left in charge of a watchman. The Indians were discharged, and the white members of the party returned to San Francisco.

The funds available are to be used in the removal of three rocks dangerous to high-water navigation in the 12 miles above El Dorado Cañon; the improvement, by closing side channels of Hatteras Bar at El Dorado Cañon; the extension of last year's work on Six Mile Rapid and Mojave Crossing; and similar works at four or five other points mentioned in Assistant Engineer Smith's report above Camp Mojave.

Money statement.

Amount appropriated by act approved July 5, 1884		$25,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$15,686 59	
July 1, 1885, outstanding liabilities	55 00	
		15,741 59
July 1, 1885, amount available		9,258 41

REPORT OF LIEUTENANT S. W. ROESSLER, CORPS OF ENGINEERS.

SAN FRANCISCO, CAL., *October* 2, 1884.

SIR: I have the honor to report as follows the results of my examination of the Colorado River at Hatteras Bar, Six Mile Rapid, Mojave Ford, and Pest House Rapid, made under instructions from Lieut. Col. G. H. Mendell, Corps of Engineers, dated August 30, 1884.

Having secured the services of Mr. H. D. Gates as assistant, I left San Francisco September 1 and arrived at the Needles the following evening. Here we were detained four days by delay in the departure of the steamboat. In the interval I secured the use of two skiffs for our return trip to the Needles and engaged the services of a pilot. Leaving the Needles on the morning of the 7th on the Mojave, we reached Camp Mojave that afternoon, where I employed three Indians as boatmen and purchased the necessary supply of provisions and cooking utensils. Leaving Mojave the same day, we reached El Dorado Cañon the evening of the 9th. The party left the boat the following day and commenced the examination of Hatteras Bar, about two miles below the Southwest Mining Company's Mill. The examination was completed the morning of the 12th.

September 12–13 I made an examination of Six Mile Rapid; September 14–15 of Mojave Ford, September 15–16 of Pest House Rapid, reaching Fort Mojave at 10 a. m. on the 16th. Here my Indians left me, but I succeeded in getting two others and reached the Needles that afternoon, where the party was disbanded. The following work was done:

(1) Plane-table survey of shore line at Hatteras Bar, Six Mile Rapid, Mojave Ford, and Pest House Rapid.

(2) Soundings over the shoals at Hatteras Bar, Mojave Ford, and Pest House Rapid.

(3) An accurate line of levels was run at each of these reaches to determine the slope of the river at these points.

There are submitted with this report four sheets of drawings giving the results of these examinations.

At the time of my examination the river maintained an unusual height for the season of the year, being 3½ feet above low water at the Needles and 3¾ feet at El Dorado Cañon, where the river is wide, and as high as six feet at Six Mile Rapid, where the river is contracted. The soundings are reduced to low water. At Hatteras Bar reductions are accurate, being obtained from a tide record kept at the mill; at Mojave Ford and Pest House Rapid the reductions are approximate.

In addition to the foregoing localities, my instructions contemplated examination of any other points where improvement might be needed; also an examination of the river above El Dorado Cañon as far as practicable. Owing, however, to the comparatively high stage of the river, it was not believed that such examinations would furnish any reliable information, and none were made.

The high stage has also defeated the object of the special examinations made, which was to supply data in sufficient detail that definite improvements as to character, location, and cost could be suggested for these places. Sufficient information, however, has been received to enable me to present a plan which, within the limits of the appropriation, it is believed would afford the greatest benefits.

NAVIGATION AND COMMERCE.

The traffic on the Colorado River has been materially reduced by the completion of through rail connections through Northern and Southern Arizona. The trade to points in the interior of Arizona, which formerly came by river from Yuma to the nearest distributing point, now takes the more direct route by rail, leaving only a local traffic which supplies a narrow belt of country adjacent to the river.

Before the completion of the railroads the river traffic for a period of nineteen months—May, 1877, to January, 1879—as given in Captain Payson's report of 1879, was 15,725.2 tons. From May, 1883, to May, 1884, a period of 12 months, the trade amounted to 2,936 tons, of which 1,773 tons was on the river from Yuma to the Needles. The principal traffic above the Needles consists of wood transported from Cottonwood and Mojave valleys to the mining mills at El Dorado Cañon. There are two mills at this point, only one of which, however, has been established on a permanent working basis. In 1883 1,455 cords of wood were carried for this mill and 392 tons miscellaneous freights, for which was paid $14,532.30 freight.

The mining interests are growing in importance and now supply nearly one-half the river trade.

Between Yuma and the Needles and above as far as Camp Mohave the river can be navigated at all stages; between Camp Mojave and El Dorado Cañon the time of navigation is limited to a period of three to four months during the summer floods—May, June, July, and August.

The last supplies of the season reach the mills about the 1st of September. These usually last till January, when the mills are closed till the arrival of new supplies in the spring. An extension of the time of navigation from two to three months in the year, I am assured, would enable the mills to run steadily through the year.

PLAN.

The section of river proposed for improvement lies between Pest House Rapid and El Dorado Cañon, a distance of about 50 miles. Except for a short reach of 8 miles through Cottonwood Valley, it maintains a permanent course between high banks of rock or mesa. It is divided into a series of deep-water pools by bars of gravel, cobble, or bowlders, which, becoming shoal at low water, form the obstructions to navigation. The principal shoals are Hatteras Bar, Four Mile Rapid, Six Mile Rapid, Whirlpool Rapid, Rapid at head of Round Island, Rapid in east channel Round Island, Bowlder Rapid, Mojave Ford, Gravel Bar below Hardyville, and Pest House Rapid. To

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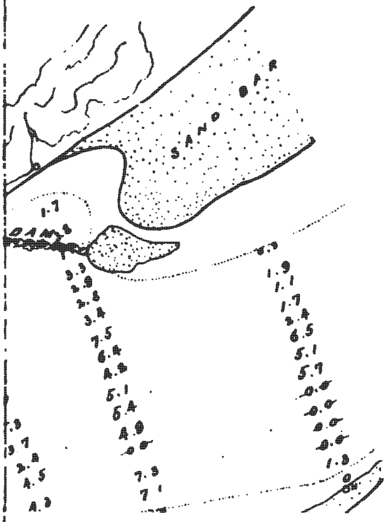
SAND BAR
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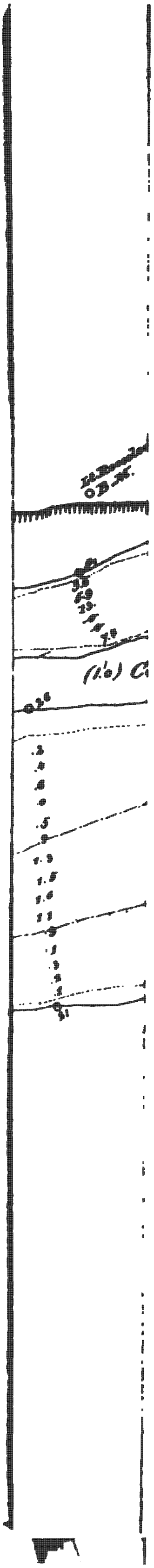

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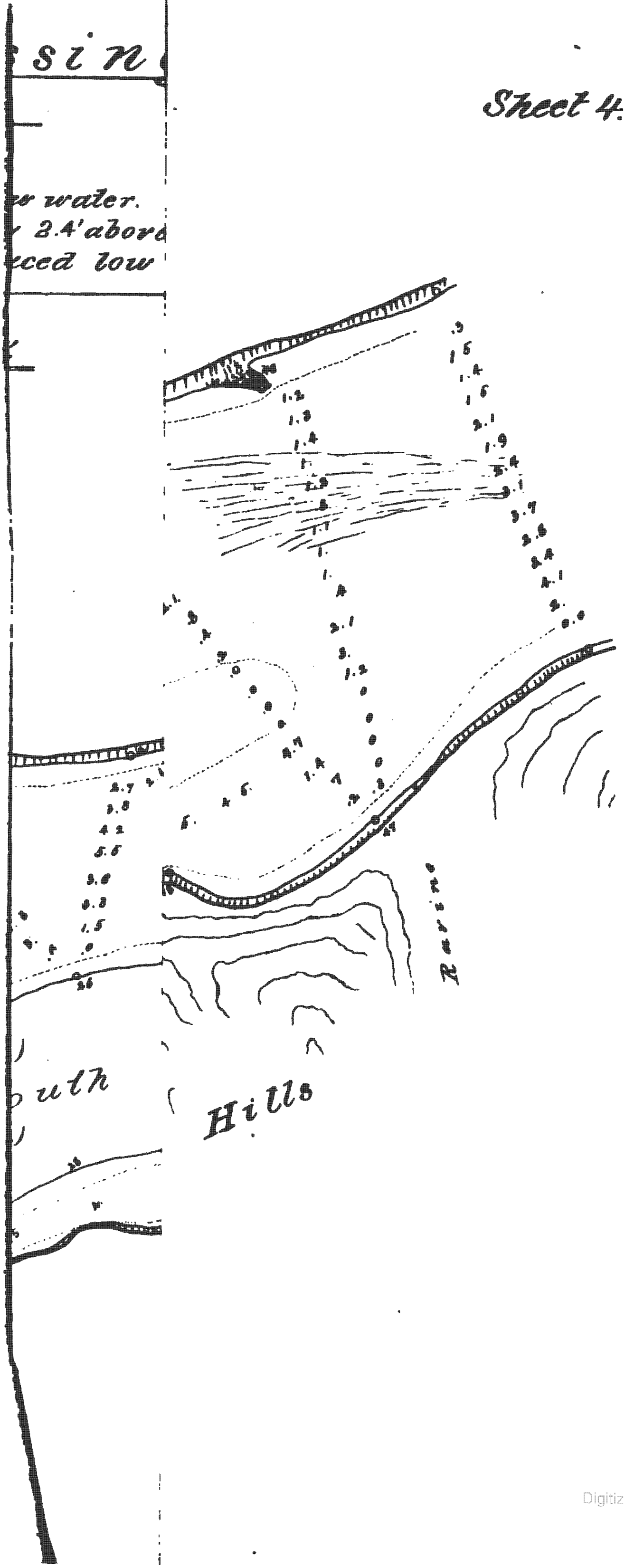


improve these so as to afford extreme low-water navigation would require the expenditure of a sum far beyond the limits of the present appropriation. The plan therefore provides only for the improvement of the worst places, so as to extend the time of navigation as much as possible. The places which have heretofore given the most trouble are Mojave Ford, Six Mile Rapid, and Hatteras Bar, and an improvement of these I am assured by the river men will extend the period of navigation two to three months in the year. The following is a description of these localities:

MOJAVE FORD.

I was unable to obtain the exact stage of river at this point, and the results of the examination are therefore not considered reliable as to the low-water condition of the river.

From all information obtainable the following appears to be the habitual condition of the river at low stages.

The river is divided into two branches by a high cobble-ridge. The right branch, which is never used, is crossed at the upper end by a gravel-bar with a few inches of water in a swift rapid over it. The left branch is crossed by a gravel-bar stretching from the foot of the island diagonally across the stream towards the left bank, giving less than 1 foot of water. The plan for this place contemplates the excavation of a channel 150 feet wide and 3 feet deep through the bar and the construction of a cobble-dam on the crest of the bar, to contract the width of the river. The plan also provides for the construction of a dam to close the right branch, at its upper end.

SIX MILE RAPID.

The river makes a bend to the left, and is suddenly contracted at the apex by a high projecting rock from the left bank and a ridge or flat of bowlders putting out from the right bank. The ridge extends diagonally down-stream and joins the left bank 1,000 feet below. At the time of my examination the river was about 6 feet above low water, and no bowlders could be seen but the general direction of the ridge was easily traced from the appearance of the surface of the water. At low stage some of the bowlders rise within a few inches of the surface and form the principal obstruction at this point. A second obstruction is formed in the steep slope at the head of the rapid, which, at a stage of 6 feet, was 0.97 feet in a distance of 140 feet, or nearly 37 feet per mile, with a current of 6 miles an hour. To make the crossing here steamboats are compelled to heave over on a strong line secured to the bank above. As the river falls the slope and current are diminished, and on several occasions the boats have been able to effect a crossing without the aid of a line. Unlike most other rapids, which disappear at high stages, this place becomes more of a torrent the higher the river rises.

At the time of my examination the width of the river at the narrowest place was 350 feet; at points 800 feet above and below the width was 600 feet.

The course of steamboats at medium and low stages is accurately laid down on the map and crosses the ridge nearly perpendicularly where there is a narrow channel between the rocks. On the downward course it is difficult for the boats to make the quick turn required here to cross the ridge, and the place is approached with much uncertainty as to the safety of the passage. It is the most dangerous point between the Needles and El Dorado Cañon.

The plan of improvement for this place contemplates the removal of bowlders from the ridge, making a channel 200 feet wide and 3 feet deep. The bowlders vary in size to 5 feet diameter, and are cemented together by a finely divided clayey sediment. The part of the ridge through which the channel is recommended is below the point of greatest contraction and greatest slope, and the effect, it is believed, will be an increase of the slope at low stages without a material reduction in the water-level of the pool above, by which new obstructions, now hidden by an ample sheet of water, might be uncovered. The increased slope will make the place more difficult to heave over, but the danger of the crossing will be removed.

HATTERAS BAR.

The river at this point is from 1,200 to 1,300 feet wide between banks, contracting below the obstruction to a width of 500 feet from shore to shore. The banks are permanent, that on the right a compacted sand deposit, bordered by high mesa; that on the left a steep sand and gravel deposit overgrown with willows. At the lower end of the reach high hills come down to the left bank.

Heretofore at low water a broad bar of cobble has put out from the left bank, leaving a narrow channel 2,400 feet long and 200 feet wide between it and the right bank, barred at both ends by a gravel ridge. This was the condition of the bar at the time of Captain Payson's survey of 1878–'79, and, as I am informed, has been its condition since. Present indications, however, point towards a closing of the old and the formation of a new channel through the cobble plat located about midway between the banks.

At the time of my examination the river was divided by two cobble ridges about 2,500 feet long into three branches carrying about the same amount of water. The left branch is deep at the lower end and barred at the upper end by a cobble ridge, which at low stage rises nearly to the surface and converts the branch into a deep-water slough, open at the lower end. The right branch is deep at the upper end and barred at the lower end by a wide cobble ridge or flat, giving less than one foot for a distance of 1,000 feet. The middle branch, which is now used by the steamboat, is barred at the upper end by a cobble ridge, giving less than 2 feet over a distance of 600 feet. This channel was cut out during this summer's flood, and I think it may be safely asserted will be the low-water channel the coming season. The plan suggested for this place is the excavation of the cobble or gravel ridge to a depth of 3 feet and the construction of stone dams, closing the right and left branches at the upper ends.

The bars to be excavated are of gravel and cobble of varying sizes firmly cemented together by a fine clay sediment. A method which has been used to deepen the gravel bars on the upper Mississippi, it is believed, could be successfully applied here. This method is to loosen the material by charges of dynamite and then to drag the bar by a rake or drag of suitable construction, drawing the material into the deep pool below. The swift current over the bars will aid in moving the loosened material.

The dams will be exposed to violent tests from the summer floods, and are therefore designed as outworks of timber filled with stone, and of square or triangular cross-section, as they are opposed obliquely or squarely with the current. The timbers will have to be obtained from the Needles; stone can be found in abundance where the dams are to be built. The months of November, December, January, and February are most favorable for the work, the river being at its lowest.

During the time of the execution of the work this portion of the river is closed to the steamboats, and all supplies will have to be brought from the Needles in skiffs for a distance of from 50 to 90 miles. Under the circumstances, and the impossibility to foresee the many contingencies that might arise, involving expensive delays, it is easy to conceive that nothing like a reliable estimate can be made as to the cost of the work. No estimate is therefore submitted.

For the same reasons it is not believed that the work can be economically done by contract if a contractor could be found at all willing to undertake the work.

Similar improvements on the Upper Mississippi and Upper Missouri are made by hire of labor and purchase of material, no contractor being found willing to undertake them.

The method recommended, therefore, is the purchase of the necessary plant, and the execution of the work by labor and purchase of material.

A plant suitable for this work is estimated at a cost of $6,000, consisting of a derrick-boat, with crab capstan and engine, a quarter-boat and bateau.

Details for their construction have not yet been prepared.

I have the honor to be, very respectfully, your obedient servant,

S. W. ROESSLER,
First Lieut. of Engineers.

Capt. A. H. PAYSON,
Corps of Engineers, U. S. A.

REPORT OF MR. W. P. SMITH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
San Pedro, Cal., June 6, 1885.

SIR: I have the honor to submit the following report upon the improvement of the Colorado River, made under your directions from November 1, 1884, to April 1, 1885:

After considerable inquiry, discussion, and thought as to what might be the best plant to put on the river, that would be the most suitable for the work required to be done; that would combine quarters for the men employed, and could be used for raising and moving large bowlders, carrying material for dams, &c., it was decided to construct one boat only that would serve all purposes.

In November a barge was commenced, to be 100 feet in length, 26 feet beam, and of very light draught. It was supplied with a derrick capable of raising 12 tons and a steam capstan for moving the barge and handling the derrick. The frame was set up in San Francisco, then taken down, and, with the material for completing, shipped by rail to the Needles, a station on the Atlantic and Pacific Railroad, on the Colorado, 245 miles above Yuma. A force of carpenters and calkers left San Francisco December 7, and built the barge near the railroad bridge, 2 miles from the station. On January 8 the barge was ready to start up-river. Arrangements had been made with the railroad company owning the steamers on the river to tow the barge as far up-stream as the stage of water at the time would permit, and it was understood that the steamer would leave Yuma on January 1. From some misunderstanding the steamer did not leave Yuma until January 10, and then the river had fallen so low that it took her until the 25th to reach the Needles.

On the morning of the 26th we left the Needles in tow of the steamer and ran that day to Fort Mojave, where we stopped to deliver freight. The next day continued up and ran until dark, stopping for the night near Bull's Head Cañon. The next day, the 28th, we made Mojave Ford or Crossing, over which the steamer could not go. There was less than 2 feet of water on the bar.

Our barge, with stores and material for the season's work, drew less than 9 inches. We got up steam in the boiler and pulled ourselves over. The steamer returned to Yuma.

The intention, and which was carried out, was to go as high up as El Dorado Cañon, 85 miles above the Needles—make examinations on the way up, and work as we dropped down-stream, at such places as we thought we might benefit during the short season before us.

The distance from where the steamer left us to El Dorado Cañon is 34 miles. This was made in a few hours less than seven days, and nearly one whole day was lost from the anchor catching in a snag in mid-stream and stopping to clear it. This was our method of moving up-stream: We had two skiffs. Into one of them a line was coiled from a few hundred feet to 2,000 feet long, and the Indians rowed or towed this skiff as far up stream as the nature of the river would permit, and then, fastening the end of the line to a tree or rock or burying an anchor in the sand, would come down with the current, paying out the line astern. Coming to the barge the line was taken to the capstan, and when there was no special rapid, pulled the barge up stream at the rate of 2 miles per hour. The second skiff was working itself up-stream in the mean time with another line. So one skiff was always working up-stream and one alongside receiving the line from the capstan. The capstan was rigged with a fast and a slow purchase. In the swift rapids a 4½-inch line was well tried, but the capstan never failed to pull us steadily over. On February 4 we arrived at El Dorado Cañon, 7 days from Mojave Ford and 10 days from the Needles.

One of the points where improvements were needed was at Hatteras Bar, 1 mile below El Dorado Cañon. The condition of the bar was the same as described in Lieutenant Roessler's report of October 4, 1884, making the allowance for the fall in the river, which was 2.5 feet since the time of his survey. As predicted by Lieutenant Roessler, the middle channel was the low-water channel of this season. The left channel was nearly closed by the cobble bar at the head and the right-hand channel by a gravel bar at the foot.

Over the bar at the head of the left channel the river flowed only a few inches deep, and after crossing the bar, some 200 feet wide, made a deep and narrow channel, which kept the left bank and widened as we went down.

The right-hand channel soon after leaving the head of the gravel island shoaled to 2 feet and escaped in many small outlets at the foot of the island.

There were two ways suggested to me to improve this place: one to close the left and right channel, confining the river to the middle one; and the second to close the right and middle channels and open the left-hand one by cutting through the gravel bar at the head. The first of these, after making a survey, I concluded would not succeed for the reason that not sufficient increased velocity in the current would be obtained to start the gravel on the bar, and the shoal was too long (some 2,000 feet) to think of dredging or scraping.

The water would be raised some in the channel, but unless the dam closing the left channel was very long the water would escape over the left-hand cobble island into the left channel and be lost to the middle channel.

The second plan, closing the right and middle channel, seemed the one promising the best results, but when I ascertained that the dam must be 600 to 700 feet long, concluded, with the short season left us, and the more urgent work below, it would not be advisable to commence it.

We accordingly moved down-stream 4 miles to Six Mile Bar, where it was necessary that something should be done this season.

Steamboat-men claim that Six Mile Rapid is the most dangerous point on the river below El Dorado Cañon. The numerous bowlders directly in the channel made it dangerous at or near low water, and after the river raised 8 or 10 feet the grade of the rapid became so great that it was very difficult to haul over. The reef of bowlders obstructing low-water navigation crosses the river diagonally, and was nearly 200 feet wide.

When we arrived the river was 1.5 feet above low water. Two of the bowlders were just awash and some thirty more had less than 2 feet over them, and they were scattered entirely across the river, so that it looked impossible for a boat running the rapid to escape them all.

Our improvement here made was a removal of the bowlders, clearing a channel 150 feet wide and to 3 feet of water at that stage. The bars on the river below would prevent steamers coming up when the river was lower, therefore 3 feet of water was considered all that was necessary for the present. Besides the removal of the bowlders, an attempt was made to relieve the rapid at the head by widening the river, and, if possible, lessen the grade. At Johnson's Rock the river at low water is only 175 feet wide. The bowlders and cobble from the point of the bar opposite the rock were removed 60 feet from the water's edge and the bar lowered 3 feet, giving the river that additional cross-section at this point. The rest of the bar, which was here 400 feet wide, was covered with bowlders of all sizes up to 10 tons' weight and many of them rising several feet above the general level of the bar, obstructing the flow of high water. The largest and most prominent of these were drilled and blasted into small pieces.

The bowlders taken from the dry bar were placed in the form of a wing-dam from the left bank below the rapid. to confine the water at the foot of the rapid and assist in lessening the grade. We remained at Six Mile Rapid for twenty-five days, and in that time removed from the channel 36 bowlders from 1 to 12 tons' weight each. Eight were over 5 tons and 1 of 12 tons.

Three hundred and eight tons of bowlders and cobbles were removed from the dry bar in widening out the head of the rapid and with which a wing-dam 150 feet in length was built at the foot of the rapid. One hundred and fourteen of the largest bowlders on the bar between low and high-water lines were drilled and broken up. The derrick and capstan on the barge handled stone of 12 tons with ease and safety. On March 3 we left Six Mile Bar and dropped down to Mojave Ford or Crossing, 28 miles. An examination was made, and the practical thing to do this year seemed to be to close the west channel around Northwest Island by a dam of stone. About one-third of the river was going down this channel with the river 2.6 feet above low water. Southwest Island is about 3,000 feet long and the ford or crossing is at the lower end of the island, the bar crossing obliquely to the left bank of the river. Bowlders and cobbles were found on the right bank at a convenient distance above the site of proposed dam, and the barge was loaded, dropped down to the dam, and built it in eleven days, taking 900 tons of stone. The dam connected the right bank with the head of the island, and was 464 feet long, 20 feet wide at base, and 200 feet of it was 5 feet high, the rest from 2 to 5 feet high.

The immediate effect of the dam was to raise the water in the open channel six-tenths of a foot and lower the west channel 500 feet below the dam, 2.4 feet, the fall at the dam 3.2 feet. I do not expect that the best effect of the dam will be seen until another low water, when it is expected that the west channel will not open at all but that the island will then be the west bank proper of the river.

If this does not make a sufficient-water on the crossing, a dam must be run from the lower end of the island towards the east shore, contracting the river directly on the bar.

It was now March 18, and the river was at the 3-foot mark and rising steadily. The only place where it was thought an improvement could be made that would warrant the expense was at Bowlder Rapid, 1¼ miles up-stream; so on that day we moved up and began widening the throat of the rapid, which is formed by a gravel, cobble, and bowlder bar on both sides, confining the river at low water to 120 feet in width. The left-hand bar was shelving, and permitted the river to flow smoothly over it. The right-hand bar was formed in ridges running at right angles to the current, producing at high water a succession of rapids, where the force and body of the current seemed to be.

We spent eight days at this place, and in that time moved 550 tons of stone from the point of the right-hand bar back into a recess of the right bank, which widened the channel-way 100 feet and lowered the bar 2 feet. On removing the large bowlders and cobble from the surface we found a large proportion of sand mixed with them underneath, which the next high water will wash away, and another layer of cobble 2 feet deep can be removed the next low water. To facilitate this scour two ditches were cut, 4 feet wide and from 3 to 4 feet deep, parallel with the current and across the bar to give the high water a face to cut against.

The river was now up to the 4-foot mark, and I knew of nothing more that could be done to advantage this season.

On March 26 we dropped down to Hardyville, the safest place to leave the barge during the high water, and, after giving it a thorough cleaning up, left her in charge of a keeper. Two days later, on March 28, we reached the Needles, where the Indians were paid off and discharged, and the white men of the party returned to San Francisco.

The force employed during the two months the barge was actually in commission was: 1 assistant engineer, 1 foreman and pilot, 1 mate, 1 steam engineer and blacksmith, 1 carpenter, 1 rodman, 1 cook, and a crew of Indians varying from 12 to 34. The laboring work and handling the barge was done by Indians, for which service 75 cents per day with board was paid.

For water work, such as moving the barge, handling small boats and lines in all ways, the Indians are as serviceable, perhaps more so, than any white labor we could hire for the same service. For labor with shovel or barrow they were worth the price paid and no more. The greatest trouble with them was to keep the same ones contented for more than three or four weeks. It would be advisable to change them once a month if possible.

SUGGESTIONS FOR FUTURE OPERATIONS.

The river was examined for 12 miles above El Dorado Cañon or to the head of Roaring Rapid. As the steamers make occasional trips during high water for 75 miles above El Dorado Cañon, chiefly for salt used in the reduction of ores, I would suggest the removal of three rocks within the distance examined.

In Roaring Rapid is a very dangerous rock directly in the channel and in the swiftest portion of the rapid. A sketch is shown in my note-book. When I was there the river was 2 feet above low water and the rock at the water-surface was 12 by 7 feet and the highest point 7 feet above water. It can be blasted out, but the barge must be taken there, as it is not safe to work from a small boat, the current is so swift. This is the most dangerous obstruction in the portion of the river navigated above El Dorado Cañon.

In Papoose Rapid, 5 miles above El Dorado Cañon, is a large bowlder with top 2 feet above low water. This can be removed by drilling and blasting.

Explorer's Rock, 4 miles above El Dorado Cañon, is the one which sunk the steamer of Lieutenant Ives's expedition. It is just awash at low water and can be removed or enough blasted off to make it harmless.

Below El Dorado Cañon we have many places that can be improved with the time
and funds. First comes Hatteras Bar, 1 mile below the cañon, where a dam will prob-
ably be needed closing the middle and right-hand channels.

At Six Mile Rapid, if the river should go to its low-water mark, more of the bowld-
rs can be taken from the channel and more from the dry bar on right-hand shore. I
would suggest that a channel be opened east of Johnson's Rock by blasting down
he high points of cement and cobble. This will relieve the rapid at the head, where
most of the difficulty is experienced.

The bars at head of Round Island and at head of Cottonwood Island were both
ood this year, but may need attention another year.

At Bowlder Rapid the river was 4 feet high when work was done there this year.
t or near low water, more of the cobbles and bowlders should be taken from right-
and bar to widen the rapid at the head.

At Mojave Ford or Crossing, the dam from the lower end of Southwest Island will
robably be needed.

Deep Rapid, 2 miles below Mojave Ford. Bowlders could be taken from each point,
hich would widen the channel and improve it.

Pest House Rapid was good this year; had 3 feet of water. It looks as if the
annel would be down the east bank another year.

Greek Rock, 8 miles above Hardyville, is much in the way; top 1.2 feet above low
ater and directly in the channel. It can be easily blasted down. The above are
e points where it appeared to me work would be the most needed next year. The
ect of the present high water cannot however be foreseen.

I notice that where the bars adjacent to all rapids slope evenly down to the water,
have a swift even current, but not a very troublesome rapid. When bowlders are
t in ridges at considerable angle with the current, a bad rapid is formed, steep,
ubled, and swift, especially at the upper end. This applies to sand in some degree
well as cobble and bowlders.

I wish to give to Capt. J. A. Mellon, who acted as foreman and pilot, much of the
dit of what we were able to do in the short season available. His long experience
navigating this river and in working Indians made his services invaluable.

There are sent to accompany this report two note-books and four maps: Hatteras
r, Six Mile Rapid, Bowlder Rapid, and Mojave Ford or Crossing, each on a scale
1 inch to 200 feet.

Respectfully submitted.

W. P. Smith,
Assistant Engineer.

Capt. A. H. Payson,
Corps of Engineers, U. S. A.

R R 6.

PRELIMINARY EXAMINATION OF YUBA RIVER, CALIFORNIA.

United States Engineer Office,
San Francisco, Cal., October 24, 1884.

GENERAL: Referring to the examination or survey of the Yuba River,
ifornia, provided for in the act of July 5, 1884, and which I was di-
ted to make by paragraph 9, Special Order No. 118, dated headquar-

ters Corps of Engineers, Washington, D. C., September 10, 1884, I have the honor to submit the following report.

This is forwarded directly to the Department, in accordance with instructions given me by Lieut. Col. George H. Mendell, Corps of Engineers, now absent on a tour of inspection in Oregon.

The Yuba River is not and never was a navigable stream. Leaving the foot-hills some 10 miles above its junction with the Feather, it has from that point filled up its bed with the detritus of hydraulic mining to a level several feet above the original banks, and further spread out these deposits over the adjoining country in a plain of sand and gravel more than 16,000 acres in extent.

Through this plain the river in low stages winds in sluggish, turbid, and divided streams, impracticable even for skiffs, and over its entire area spreads unchecked in times of flood.

The map of the Lower Yuba, forwarded with the report of Lieut. Col. Mendell on protection of the navigable waters of California from injury by mining débris, published as Appendix M M, Report of Chief of Engineers, 1882, shows the conditions then existing, which are now practically unchanged.

The only way in which work upon the Yuba could be considered as directed toward the improvement of navigation would be in the restraint of the enormous deposits now accumulated in its bed and along its banks in such manner as to prevent or gradually diminish their discharge into the Feather and Sacramento rivers. As measures to these ends have already been the subject of elaborate investigation and report, and as the whole matter is now in abeyance, I cannot see that anything further in the way of examination is now necessary.

The objectionable position of the mouth of the Yuba in reference to the direction of the Feather was one of the subjects mentioned in a letter addressed June 9, 1883, by Mr. A. C. Bingham, then and now mayor of Marysville, to the honorable the Secretary of War. This letter, being referred to Lieutenant-Colonel Mendell for report, was replied to by that officer in a letter to the Chief of Engineers, dated July 24, 1883, in which the ground was taken that the proposed corrections at the Yuba's mouth would not be of benefit to the navigation of the Feather, and that the chances were considerable that such a new outlet if made might be completely obliterated by a single flood.

To ascertain, if possible, the wishes of the people in this matter, and the object of the clause in the act of July 5, 1884, I have visited Marysville and had an interview with Mr. Bingham, the mayor, who is in charge of, and very actively interested in, the extensive levee and bank protection work carried on each year by the city.

He was entirely in ignorance of any cause for the provision in the act referred to, unaware of any efforts having been made for work by the General Government on the Yuba, and could suggest nothing called for in that direction other than the impounding or restraint of existing deposits before referred to.

Under these circumstances, no reason can be seen for further action in the matter.

Very respectfully, your obedient servant,

A. H. PAYSON,
Captain, Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX S S.

IMPROVEMENT OF THE COLUMBIA AND WILLAMETTE RIVERS BELOW PORTLAND, OREGON, AND OF THE MOUTH OF COLUMBIA RIVER; OF THE ENTRANCE TO COOS AND YAQUINA BAYS AND MOUTH OF COQUILLE RIVER, OREGON, AND OF CERTAIN RIVERS EMPTYING INTO PUGET SOUND, WASHINGTON TERRITORY—WATER GAUGES ON COLUMBIA RIVER.

REPORT OF CAPTAIN CHARLES F. POWELL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Columbia and Willamette rivers below Portland, Oregon.
2. Mouth of the Columbia River, Oregon and Washington Territory.
3. Entrance to Coos Bay, Oregon.
4. Entrance to Yaquina Bay, Oregon.
5. Mouth of Coquille River, Oregon.
6. Skagit, Steilaquamish, Nootsack, Snohomish and Snoqualmie rivers, Washington Territory.
7. Chehalis River, Washington Territory.
8. Gauging waters of the Columbia River and principal tributaries.

EXAMINATIONS AND SURVEYS.

9. Bar at the mouth of the entrance to Nehalim Bay and River, Oregon.
10. Olympia Harbor, Washington Territory.
11. Puyallup River, Washington Territory.
12. Willapah River, Washington Territory.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., August 7, 1885.

GENERAL: I have the honor to transmit herewith annual reports upon river and harbor improvements under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

CHAS. F. POWELL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

S S 1.

IMPROVEMENT OF COLUMBIA AND WILLAMETTE RIVERS BELOW PORTLAND, OREGON.

The project provides for a ship-channel of 20 feet depth at low water on 100 miles, by contraction and shore protection works at four bars from Portland to Columbia City; by temporary improvement at the bars during construction of the works, and at three shoal places below Columbia City, and by snagging operations. The mean tide at Portland, on a low river stage, is about 2 feet; at Astoria it is 7.5 feet above the plane of reference for soundings.

The original estimate of the cost of the permanent works is $298,974. Of the total appropriation, $365,000, since the adoption of the present plan in 1877, about $254,000 have been applied to the permanent works. The estimate for their completion is derived as follows:

Saint Helen's Dikes, commenced on modified project (1884)	$64,762
Swan Island Dike, not commenced, modified project (1879), proportionate cost of whole to that of awarded contract (1879), for part	54,954
Ten per cent. thereon for inspection and contingencies	5,495
Auxiliary works at Post-Office Bar and mouth of the Willamette	27,734
	152,941

The reasons for the excess of cost are the addition of works to attain the object as needed in late years, viz: A navigable channel at low water by long vessels drawing 20 feet, requiring a wider and deeper channel than first contemplated; extension of shore protection on account of decay of banks caused by deep vessels under high speed, and inadequacy of appropriations, which has not permitted economical work. Completion of the permanent works was provided to be made in two years, while actual work on about one-half of the structures has extended through six years.

The cost of maintenance and temporary improvement for next year is estimated as follows:

Operating dredge-boat with tender for six months	$15,000
Hire of ship for propeller sluicing	15,000
Building and fitting snag-boat	35,000
Operating snag-boat for six months	10,000
Local surveys	3,000
Maintenance of works and plant	10,000
Contingencies	9,600
	97,600

Snagging operations, heretofore unavoidably confined to the ship-channel, have been inefficient from the want of a regularly equipped snag-boat belonging to this improvement. Increase of rafting and extension of river steamer routes call for snagging along slackwater, near landings and at mouths of tributaries and sloughs. A snag-boat is also needed for aid on the permanent works as a tender in propeller sluicing. No improvement is more advantageous, considering cost, than snagging operations.

The estimate for temporary work, from a year's suspension of operations, is based on an expected deterioration of the channel where permanent works have not been applied, and on an urgency for opening a channel elsewhere in the early part of the year, and for the lower half of the reach to only 20 feet depth at half tide on a low river.

The number and tonnage of sea-going craft and the schedule time of steamships on the Columbia River justly require a better channel than can be afforded at reasonable cost by temporary methods. Below Saint Helen's are three principal bars, two shoal places, and one rock construction. The cost of removing the latter is approximately estimated at $60,000. Permanent works at the other localities will probably cost as much as the works above Saint Helen's will have cost, or about $407,000, making a total of $467,000 for a permanent channel for 20-feet draughts on the tidal section.

All the constructions above and below Saint Helen's could be profitably completed in two years, requiring only thereafter a small amount for maintenance and snagging.

The estimates are for attaining the object of the present project, but vessels of nearly 22 feet draught have loaded at Portland, and already there is need of a navigable channel 24 feet deep at low water on the upper half of the reach under improvement, or 4 feet more than contemplated by the present project.

OPERATIONS DURING THE YEAR.

Surveys or examinations after the June freshet, 1884, gave the following ruling depths reduced to low water at the various bars:

	Feet.
Swan Island	14½
Post-Office	16½
Mouth of Willamette	19
Saint Helen's	12½
Martin's Island	19
Walker's Island	16

Operations of 1884 had consisted of extensive dredging at Swan Island and deep sluicing at Saint Helen's, as the worst places. The artificial channels thereby made were useful only for the following low-water season; before the end of the year, as may be noticed above, they had completely filled, Walker's and Post-Office also being of insufficient depth.

As authorized by the plan for the application of the appropriation of July 5, 1884, dredging at Post-Office and sluicing at Saint Helen's and Walker's were promptly undertaken to furnish a channel during the approaching and coinciding low water and shipping seasons. The Post-Office dredging also had for object by widening the channel way to permit the occupation of one side by permanent works.

Extensive and early dredging at Swan Island was conducted by the city of Portland.

These four works bridged over the low season so that lighterage of freight, whose cost is $1.25 per ton, and delays to shipping, on account of shoal water, were quite inconsiderable; in fact barges and crews heretofore engaged in lightering went out of business during the shipping season from want of patronage. Excluding Swan Island dredging, the cost of the temporary work, applied as an urgent expedient, was about 23 per cent. of the appropriation.

The temporary channels have again disappeared, excepting the Post-Office Channel, where some contraction works are built. Stronger reasons, on account of larger crops and lower prices, exist now than formerly, for immediate relief to forestall low water.

Snagging operations conducted from time to time, as necessity required and the means permitted, resulted in the removal from the ship channel of 100 snags, 7 guide-piles no longer needed, and drift from dikes.

The construction plant was overhauled, increased by the addition six scows and a floating drop-hammer pile-driver, and was worked fro early August to late January, except during a suspension of operation about midwinter. Piles, brush, stone, timber, iron, rope, generally small material, and the use of a tow-boat were obtained upon bids, afte public notice.

The construction work was by hired labor. Some stone, howeve was placed as job work under agreement, and the United States tow-boat Cascades was substituted for the chartered boat November 4.

The following structures were built:

	Feet
Head of Willamette Slough:	
Longitudinal dike, length	2,[illegible]
Wings of navigation opening	[illegible]
Cross-dikes	[illegible]
Left bank, Post Office Bar:	
Longitudinal dike	[illegible]
Wing	[illegible]
Head of Pearcy's Slough:	
Two dams	1,[illegible]
Coon Island:	
Shore protection, rebuilt and extended	1[illegible]
Trial bank revetment of stone pavement	[illegible]
Trial bank revetment of willow and cottonwood shoots	[illegible]
Sauvie's Island:	
Trial bank revetment of stone pavement	2,[illegible]
Trial bank revetment of willow facines mats	[illegible]
Trial bank revetment of stone pavement	[illegible]
Saint Helen's:	
Longitudinal dike	2,[illegible]

The navigation opening in the dike at the head of the Willamette Slough and the lower end of the incompleted Saint Helen's Dike was marked by pile clusters to above high water. The bottom of the opening was partly revetted with a fascine mat, and the lower wing of the opening heavily faced with bolsters, and marked by high fender piles The wing and the dike at the head of the slough, where each crossed a deep hole, were reinforced by iron ties to brace piles. Banks at shore ends of the dikes and dams were revetted. The facine dam at Bybee's of 1883, was brought to grade by a filling where settlement has occurred.

Two progress maps are herewith, showing locations of works to date; one sheet of sketches, showing methods of construction, is also submitted.

The season was very favorable for work until December 16, when stormy, cold weather, a sudden freeze-up in the Columbia above the mouth of the Willamette with running ice below, stopped construction for four weeks. The plant was kept in readiness for adding brush work at the Saint Helen's Dike and ballast to the new Pearcy's Slough dams. The tow-boat, Cascades, which had been sheathed with sheet-iron, broke a passage through the ice of Willamette Slough releasing some boats which were fastened there. The tow-boat also opened Hayden's Slough, permitting the Vancouver and La Camas steamers to earlier resume their trips.

No damage to the works was done by the ice. Drift brought by a freshet at the end of the freeze-up disrupted a 150-foot section of the Saint Helen's Dike, which was removed and new work substituted. A large timber bridge-pier caisson broke through the Willamettel Slough Dike and landed against the pile-crib dam in the slough. The damage here has not been repaired.

The plant was laid up and the force wholly disbanded at the end of January. A small balance of funds on hand, with some material left

Portland. Oregon.

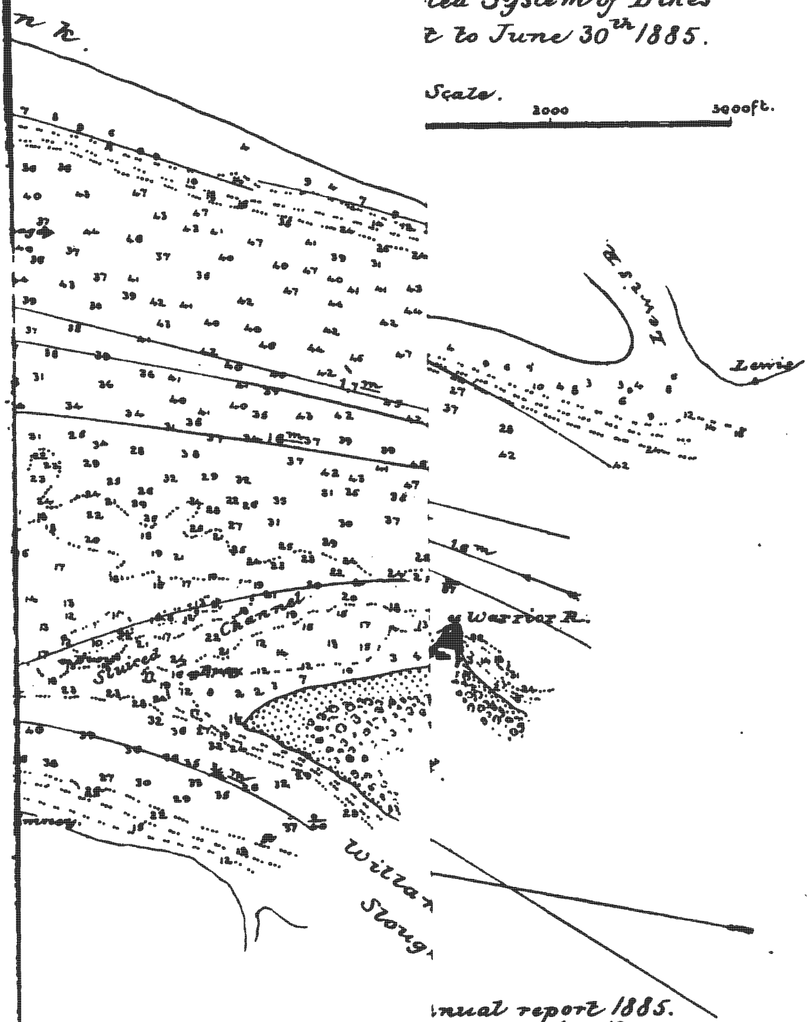
ELENS BAR.

FROM

SEPTEMBER 1884.

ted System of Dikes

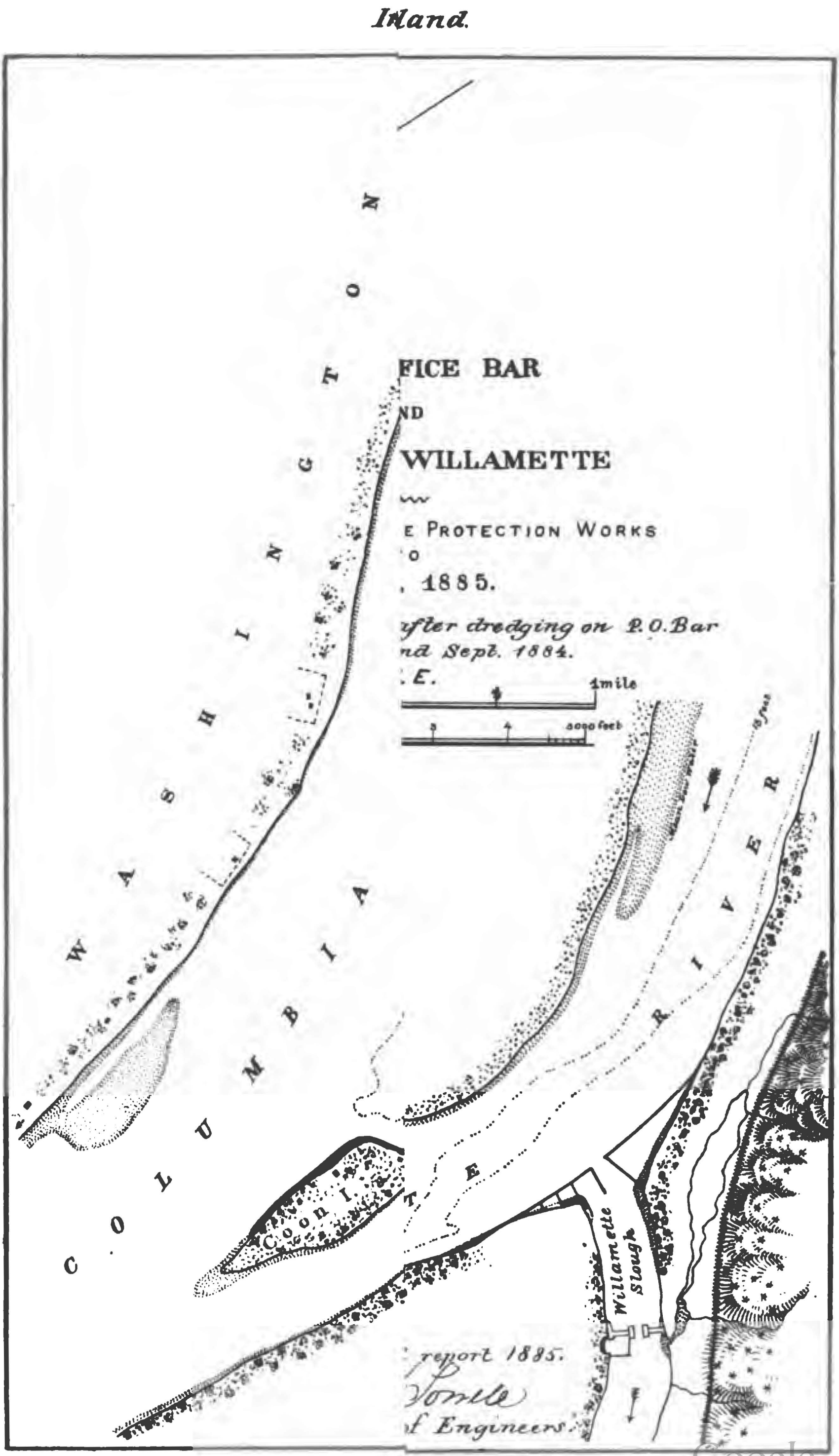
t to June 30th 1885.



nnual report 1885.

F. Powell

Captain of Engineers.



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INAL DIKE.

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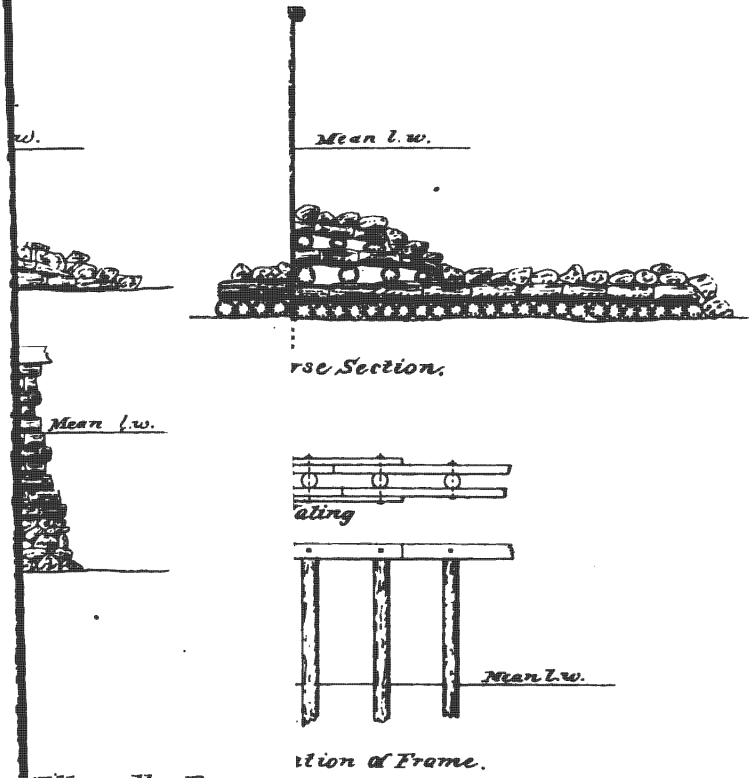


Willamette Rivers

vith annual report 1885

Cha F Powell
Captain of Engineers.

r, was used to extend the bottom revetment of the Saint Helen's Dike l strengthen one part by bracing piles. The driving of these piles, in number, was done by contract.

A comparison of a survey, May, 1885, of the lower crossing at Saint len's with the one of September, 1884, shows an advancement of the foot curve of depth of 500 feet and gives promise that a completion he longitudinal dike without the cross-dikes of the system would n the channel.

'unds have not permitted a survey since the June freshet. Sound- s of the May survey in the upper crossing or sluiced channel show a to 17½ feet, low water. A late survey by the Columbia River pilots es a greater fill. The effect of the June freshet would be to fill the iced channel and scour the lower one.

'he pilots make a written statement of fair depth existing at Post- ice Bar and at the mouth of the Willamette and of shoal water at lker's and Martin's islands.

'he present project authorized by the Department for the Saint Hel- permanent improvement is based on my recommendation of Novem- 22, 1884, and is shown in plan on one of the accompanying progress ps.

Ir. R. A. Habersham, late assistant engineer, was in immediate rge of the construction work.

ubsequent to the beginning of the season's operations detailed sur- s were made at Martin's Island and Saint Helen's, with borings on bar and current measurements at the latter place. Surveys were made of the sluiced channel and of the range-light channel at lker's Island, and of the Willamette River from Willamette Slough he mouth.

Ir. Otto von Geldern was chief of party on the principal surveys.

'he costs of the above works are:

porary improvement, including snagging	$24,135 12
struction and shore-protection works	78,759 77
veys	2,853 17
	105,748 06

DREDGING AND PROPELLER SLUICING.

'he Post-Office Bar consists of two parts separated by a deep place. temporary improvement had been made on the bar since 1876.

'he Osgood boom dredge began work at the lowest end to deepen the nnel and widen it on the east side. The material was generally silt l sand; it was disposed of by dump-scows behind the dike or along face before filled with brush, or in front of the navigation opening. hip's anchor of 3,500 pounds, and 260 feet of 1½-inch chain, a pro- ler fluke of about 1,000 pounds, and some sunken drift were lifted by dredge; one worn piece of drift, 2½ by 35 feet, had pieces of copper ls and copper fastened to it. The bank was from 3 to 6 feet high; digging to 22 feet at zero of gauge, and during readings from 5 to et.

After making this cut the dredge completed the cut at the upper , which had been commenced by the clam-shell dredge.

A pair of swinging engines, procured for the better working of the dge, was not placed until the freeze-up; no work was done after that.

'he following is a summary of work:

nber of days on which dredging was done	86
nber of cubic yards removed	47,026
atest number of yards in one day	850
rage number of yards per day	547

rk commenced August 22, 1884; closed December 13, 1884.

The bowlder (clam-shell) dredge, belonging to the Cascades C was repaired and fitted out, and worked down-stream at the uppe Her progress was slow from the worn condition of the friction ratus. After making a narrow cut through the bar the dredge withdrawn. The digging was a little harder than at the lower bar. much less imbedded truck was encountered.

The following is a summary of this work:

Number of days on which dredging was done	
Number of cubic yards removed	
Greatest number of yards in one day	
Average number of yards per day	

Work commenced September 8, 1884, closed October 21, 1884.

The steamship Walla Walla was chartered for sluicing in Augu $360 per day, including expense of working the ship. She ma channel on the Saint Helen's line of the sluicing of 1884, in san feet deep at zero of gauge by 150 feet wide and about 1,200 feet The mean gauge-reading was about 5 feet. The ruling channel d before work was 12½ feet at zero.

The cut sluiced at Walker's Island was through the upper bar of Oregon shore channel, 150 feet wide by 800 feet long. Two hun and fifty feet additionally were worked over for forcing away dep from the first sluicing. The amount of material excavated above 18-foot plane is 9,761 yards, with partial excavation below that pl The ruling depth on the line selected for sluicing was 13½ feet at The work was done during gauge-readings of about 6 feet. The ma rial was coarse sand and compacted gravel and cobble.

The whole charter time of the ship was 18½ days. The tow- Cascades was tender for the steamship at Saint Helen's, and the boat Corvallis during the Walker's Island work.

A sketch was forwarded with my report of 1884, showing the ope tion of propeller sluicing, which was described in the reports for and 1884. This was the third year of its application on the Colum River. The more I use the method the more I am impressed with merit for temporary improvement.

BRIDGING THE WILLAMETTE RIVER AT PORTLAND.

As far as known, the legal status of the unfinished Morrison Str Bridge has remained unchanged.

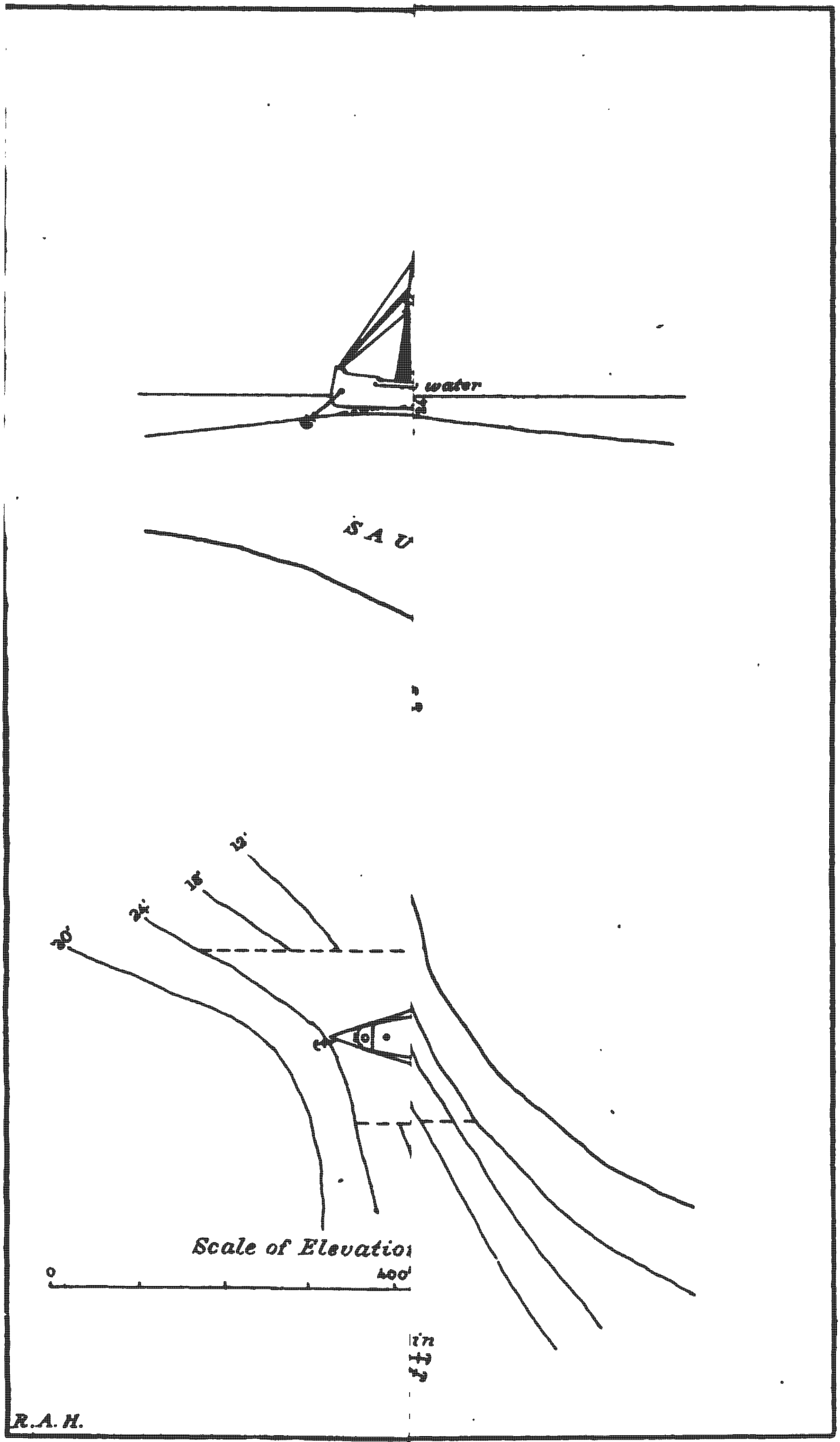
The parts built are now generally submerged obstructions. clusters to mark and protect the piers have been carried away, exc the cluster in front of pier No. 4. Trestle piling on the east side is about gone, some parts having been removed to allow escape of dri

Pier 1, 3, and 5, and 2 (pivot pier), when submerged, are marked indifferent buoys. When exposed the pivot pier is lighted.

The piling for the North Pacific Railroad Bridge, described in the last report as having been driven, was about one-half carried away winter. The company had the remaining piles removed by blasting, that now no obstruction by the piling is known to exist.

APPROPRIATIONS.

Act June 23, 1866, Lower Willamette	$15,000
Act March 2, 1667	30,000
Act July 25, 1868 (allotted)	21,000
Act April 10, 1869 (allotted)	13,365



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t July 11, 1870	$31,000	
t June 10, 1872	50,000	
		$160,365
t March 3, 1873, Lower Willamette and Columbia, from Portland, Oreg., to the sea	20,000	
t June 23, 1874	20,000	
t March 3, 1875	20,000	
t August 14, 1876	20,000	
t June 18, 1878	30,000	
t March 3, 1879	45,000	
		155,000
t June 14, 1880, Lower Willamette and Columbia from Portland, Oreg., to the sea, including bar at the mouth of the Columbia	45,000	
t March 3, 1881	45,000	
t August 2, 1882	100,000	
		190,000
t July 5, 1884, Columbia and Lower Willamette rivers below Portland, Oreg		100,000
Total		605,365

Money statement.

ly 1, 1884, amount available		$1 98
nount received by transfer of property to other improvements and by leposit		6,250 36
nount appropriated by act approved July 5, 1884		100,000 00
		106,252 34
ly 1, 1885, amount expended during fiscal year, exclusive of utstanding liabilities July 1, 1884	$105,120 92	
ly 1, 1885, outstanding liabilities	627 14	
		105,748 06
ly 1, 1885, amount available		504 28
Amount (estimated) required for completion of existing project including that of temporary improvement and maintenance for one year		250,541 74
Amount that can be profitably expended in fiscal year ending June 30, 1887		407,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Portland is an important center of rail and water transportation lines. It is the ad of ship navigation, being 100 miles inland from the port near the mouth of the lumbia River. Its foreign and coasting trade and local river traffic are large and creasing. A statement of the commercial need of the rivers below Portland, and a st measure of their desired capacity to Astoria, are given in the Report on Internal mmerce of the United States, May, 1885.

The rivers are in the collection districts of Willamette and Oregon. The nearest rts of entry are Portland and Astoria, Oreg. The nearest light-houses and works defense are at the entrance to the Columbia River.

The amount of revenue collected at Portland during the year ending June 30, 1885, as $189,481.42, and at Astoria during same period was $54,492.61.

The following refer to the district of Willamette for the year ending June 30, 1885, d are furnished by Mr. F. N. Shurtleff, collector:

Entrances, clearances, &c.	Number.	Net registered tonnage.
astwise entrances	171	206,412
astwise clearances	111	148,962
reign entrances	68	62,250
reign clearances	125	121,637
w river craft registered	8	1,182.87

*Columbia River wheat and flour fleets.**

[Compiled from Portland Journal of Commerce.]

Months.	1877-'78.		1878-'79.		1879-'80.		1880-'81.		1881-'82.		1882-'83.		1883-'84.		1884-'85.		[illegible]	
	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	Cleared.	Arrived.	[illegible]
July	1	....	1	2	4	....	2	....	9	8	1	....	2	....	2	3	2.7	[illegible]
August	2	1	6	1	6	1	6	1	9	10	11	6	8	....	4	2	6.5	[illegible]
September	16	5	11	1	9	3	7	2	19	12	8	7	3	2	9	2	10.2	[illegible]
October	29	20	18	11	16	15	4	6	31	19	20	12	24	16	16	11	12.7	[illegible]
November	11	22	12	14	11	14	6	9	17	21	11	16	18	11	21	22	12.4	[illegible]
December	5	15	6	10	10	15	7	10	18	26	6	14	6	25	26	13	10.5	[illegible]
January	4	8	1	12	8	10	8	6	18	21	7	8	6	11	11	18	7.9	[illegible]
February	2	8	1	4	5	9	2	7	12	17	2	4	1	8	8	18	4.1	[illegible]
March	1	2	....	4	6	7	4	5	9	11	....	8	4	....	4	8	3.5	[illegible]
April	1	2	....	2	8	6	12	5	6	9	1	2	4	5	5	2	4.0	[illegible]
May	1	1	....	1	....	1	16	3	2	4	....	2	2	2	2	6	2.9	[illegible]
June	4	....	....	5	1	1	5	7	5	6	....	....	....	8	....	5	1.9	[illegible]
Total	77	74	56	67	79	82	79	61	155	164	67	79	78	88	108	110	7.3	[illegible]

* Four cargoes finished with salmon.

Shipments to San Francisco, Puget Sound, Alaska, and British Columbia no cluded.

Columbia River coal fleets.

[Compiled from lists furnished by Her Britannic Majesty's vice-consul, and the Portland agent Improvement Company.]

Months.	Cargoes.				Tonnage.					
	Domestic, 1883-'84.	Foreign, 1883-'84.	Domestic, 1884-'85.	Foreign, 1884-'85.	From domestic ports, 1883-'84.	From foreign ports, 1883-'84.	From domestic ports, 1884-'85.	From foreign ports, 1884-'85.	Total, 1883-'84.	[illegible]
	No.	*No.*	*No.*	*No.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	[illegible]
July	2	1	2	3	4,486	1,660	3,195	2,727	6,146	[illegible]
August	2	2	1	4	2,884	2,146	1,543	3,975	5,030	[illegible]
September	1	1	1	1	2,241	1,208	1,390	1,480	3,449	[illegible]
October	3	3	2	3	4,007	3,138	4,227	3,047	7,145	[illegible]
November	2	3	1	3	2,959	4,831	2,268	3,598	7,790	[illegible]
December	1	4	2	3	1,889	4,664	2,900	2,381	6,553	[illegible]
January	2	......	1	4	3,958	....	2,110	3,794	3,958	[illegible]
February	1	1	2	3	1,354	1,336	4,282	2,384	2,690	[illegible]
March	1	4	3	3	1,969	5,118	2,943	1,249	7,087	[illegible]
April	2	......	1	1	3,425	....	1,116	630	3,425	[illegible]
May	1	1	1	1	1,752	595	841	1,074	2,347	[illegible]
June	1	1	2	1	2,173	598	3,329	648	2,771	[illegible]
Total	19	21	19	30	33,097	25,294	30,144	26,987	58,391	[illegible]

S S 2.

IMPROVEMENT OF THE MOUTH OF THE COLUMBIA RIVER, OREGON, AN WASHINGTON TERRITORY.

The project of this improvement is to build a low-tide jetty, about miles long, extending from near Fort Stevens, on the south cape, an by a slightly convex curve on the north to a point about 3 miles sou of Cape Disappointment. Some latitude in the length of the jetty i permitted; also for an increase of contraction by raising it or by bui ing a short work on Peacock Spit. A certain construction of stone an beton blocks resting on a foundation course, is provided for at an estimate of cost, without contingencies, of $3,710,000, although mattresses and piling in the shoaler water are recommended wherever practicable and economical. A channel depth of 30 feet at low water is intended.

The approved plan for the prosecution of this work, whose commencement on the above project under an appropriation of $100,000 was required by the act of July 5, 1884, consists of hired labor operations and purchase of materials in accordance with Article LXXV, Army Regulations, for performing necessary preliminary work; building certain accessory structures and a jetty section of 800 feet from high to low-water mark, of brush, mattress, and stone ballast to average height of half tide.

The plan for the prosecution submitted by me August 7, 1884, contemplates two methods of work, and at the beginning a third for simultaneous execution. The first, and for the greater part of the construction, is to work from land by an elevated pile tramway. The preliminary work and accessory structures authorized were provided therefor.

Notice of adoption of the approved plan was received November 7. By requirement of the Secretary of War, the detachment of infantry previously garrisoning the post was withdrawn, and the post and military reservation of Fort Stevens transferred to me November 29, 1884.

. The jetty works were stopped by receipt of a notice of a private claim to the intended and only available site for a landing wharf. The claim rested upon a purchase as tide land from the State of Oregon. The claim was examined after a survey and relocation of adjacent boundaries of the original reservation. Judging the site to be an accretion to the reservation, having been caused by the quartermaster's wharf and its extensions, the matter was submitted to the proper State authorities, with request for the revocation of the sale; this was declined, the sale being acknowledged and authority for it affirmed. The opinion in the premises of the United States district attorney was therefore asked, who stated, after a careful representation was given to him of the facts and circumstances of the case, that the claim to the site in question was invalid and of no force. It is understood that the district attorney is to take steps to have the unjust claim vacated.

Measures for going on with the work were promptly resumed, the requisite local surveys and detailed plans having already been made. Contracts were closed for building four sea-going barges; a wharf and trestle connecting it with the quartermaster's wharf, which had wholly shoaled to high tide, and for furnishing stone and piles.

The general arrangement is to hoist material by steam derricks from barges to cars and transfer it on a 3-foot gauge track to storing platforms and sheds, or direct to the jetty. The tramway rests on pile bents, and curves from the old wharf across the low sand-point in the immediate front of Fort Stevens, thence is directed on the tangent of the jetty alignment, the grade raising on the latter from 17 to 24 feet above mean lower low water. The construction buildings, consisting of engine-house, shops, store-room and office, were located about midway from the wharf to the jetty end; to the building the tramway is single track; beyond it is double track.

Thirty-pound steel rail and part timmings for 2 miles of track, a 10-ton pony truck locomotive, irons for thirty stone dump-cars of 5 tons capacity, and of a special pattern, with a hand-car and a push-car, were ordered, upon bids, from manufacturers at San Francisco or in the East. Other plant and material, including a large lot of timber, were purchased or temporarily transferred from other improvements.

The wharf and trestle, barges, and first lot of piles were delivered in

April, when a construction force was assembled, and the pile-driv for shore trestle and the receiving of plant and material were c menced. Post buildings were used as far as needed and conveni especially ones for housing and messing the employés, the latter which is done by contract under bids and specifications, outfit, fuel, a lights being furnished.

By the end of June the tramway piling had been advanced t point 430 feet on the beach below high water, or 3,510 feet from t wharf face. The superstructure and rails of the right track were l to 130 feet of the last bent of piling, and the left track to stations and 28 respectively. The construction buildings and one platf were completed, and piles driven for a second platform and for a pi driver car side-track. One flat car and ten dump-cars were set up a trucks for twenty-eight of the latter partly framed. Fifty cords of bru were cut on the reservation and bound into fascines.

All the work has been done in a substantial manner, with a view its durability and the magnitude of the work of improvement.

Pile-driving so far has been by the water-jet; some delay was caus by embedded drift in the low sand-point. A No. 6 Dow pump w placed at the fort ditch, opposite the middle of the shore tramway, a gave efficient working until the hard beach was reached. The pump w then moved to the tramway end, and, operated by the locomotive engi it took water from a tank which was supplied by regular working of smaller pump at the ditch. The pile-driving being tide-work, the loc motive was released for other service during high tide. As the pi distances again become long it is expected to drive a section at extre low water, place the pump and a boiler there, and work shorewar using salt water for pump-feed. For pile-driving in the surf or stro tides the jet is not considered easy and convenient. For such work car, to run on the double track, is being constructed, for operation of 3,600-pound steam-hammer.

The mattresses are to be of fascines 1 foot by 18 feet, bound togethe with galvanized wire, and laid from extreme high-water line, 36 fe wide, or projecting beyond outer rows of piling 10 feet on north si and 6 feet on the south side. The mats are to be in succession to lo water, one, two, and three courses thick. Beyond low water the ma are to be built upon a grillage suspended from the tramway and lowered into place.

The stone is to be of basalt, in pieces from 300 to 6,000 pounds, averaging 2,000 pounds in weight.

These details of operations of course may change, and probably will as the work advances and appropriations are adequate for extended work; but the mattress and ballast are being placed as above during the present month of July.

It is expected with the funds on hand, after reserving a small balance for care of property and for bar survey, to extend the complete brush-work to make 1,500 feet length, and to leave the work in condition for promptly resuming full operations when funds are provided.

The amount estimated for next year, $1,330,000, is for building 3 miles of jetty by permitting advantageous contracts for material and for laying the foundation course and part covering in advance where depths of water permit, following this by working from land.

The improvement is important and of magnitude.

Mr. P. G. Eastwick has been assistant engineer on this work, and Mr. Einar Pihl, draughtsman, for the greater part of the time.

The last complete survey of the mouth was made in 1883, and plotted last year on a scale of $\frac{1}{20000}$. A map reduced to one-half that scale as printed for engineer use. The maps delineating the spits by actual oundings show a well defined channel of 6 feet ruling depth, and with ore than 18 feet across the line of the jetty, and nearly half-way cross Clatsop Spit. This break is the Tillamook Chute of the bar shermen. It has probably not diminished since the survey; on the ontrary, observation and change of buoys show that the end of the plit has moved north and grown in elevation. Sand Island has been ut in two, and Peacock Spit appears as though it would separate.

These changes do not encourage a natural improvement of the bar hannel.

APPROPRIATIONS.

ct June 18, 1878	$5,000
ct March 3, 1879	5,000
ct August 2, 1882	7,500
	17,500
uly 5, 1884, for commencing jetty on plan of majority of Board of Engineers of 1882	100,000
Total	117,500

Money statement.

mount appropriated by act approved July 5, 1884		$100,000 00
uly 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$59,376 70	
uly 1, 1885, outstanding liabilities	6,326 02	
		65,702 72
uly 1, 1885, amount available		34,297 28
Amount (estimated) required for completion of existing project		3,700,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		1,330,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

bstract of proposals for construction of a wharf and trestle at Point Adams, Oregon, for improving mouth of the Columbia River, opened January 16, 1885, by Capt. Charles F. Powell, Corps of Engineers.

o.	Names and addresses of bidders.	Wharf, 34 by 98 feet.	Trestle 240 feet long.		Total amount.
			Price per linear foot.	Amount.	
*1	Paquet & Smith, East Portland, Oreg	$1,815	$7 00	$1,680	$3,495 00
2	N. J. Blagen & Co., Portland, Oreg	2,000	7 00	1,680	3,680 00
3	Henry J. Hansen, Astoria, Oreg	3,990	8 90	2,136	6,126 00
*4	Louis W. Holt, Astoria, Oreg	1,815	7 00	1,680	3,495 00
5	Surprenant & Ferguson, Astoria, Oreg	2,150	7 00	1,680	3,830 80

* Nos. 1 and 4, tie bidders, mutually agreed to award of contract to No. 4.

bstract of proposals for construction and delivery at Astoria, Oreg., of four stone-barges for improving mouth of Columbia River, opened at Portland, Oreg., January 16, 1885, by Capt. Charles F. Powell, Corps of Engineers.

o.	Names and addresses of bidders.	Price per barge.	Total.
1	Paquet & Smith, East Portland, Oreg	$5,575	$22,300
*2	John F. Steffen, Portland, Oreg	5,364	21,456
3	Thomas J. Bulger, Portland, Oreg., and James D. McKinnon, East Portland, Oreg	8,533	34,132
4	John H. Rutter, Astoria, Oreg	7,990	31,960

* Accepted.

Abstract of proposals for furnishing piles at Point Adams, "Improving lumbia River," opened by First Lieut. Edward Burr, Corps of Engineers, F. Powell, Corps of Engineers, January 30, 1885.

[Delivery to commence on or about March 18, 1885, and to be continued on ten day exceeding 3,000 linear feet.]

No.	Names and residences of bidders.	2 pi
1	Brazil Grounds, Portland, Oreg	
2	Leander Michael, Dayton, Oreg	
3	Ole Bowman, Scapoose, Oreg	
4	J. H. D. Gray, Astoria, Oreg	
5	Thomas J. Baxter, Vancouver, Wash	
6	Jacob Jordan, Peter Jordan, Irving Stevens, and J. C. Trullinger, Astoria, Oreg	
*7	P. F. Falbert, Kalama, Wash	

* Contract awarded.

Abstract of proposals for furnishing stone on United States barges or Unite "Improving mouth of the Columbia River," opened by First Lieut. Edwar of Engineers, at Portland, Oreg., for Capt. Charles F. Powell, Corps of E uary 30, 1885.

[25,000 tons of 2,000 pounds to a ton. Delivery to commence about April 15, 1885, and lots as required on ten days' notice, and at monthly rate of about 4,'00 ton

No.	Names and residences of bidders.	Place of delivery on barges, except No. 4.	Miles distant from Point Adams.	Price per ton at place of delivery.	Total amount at place of delivery.	Estimated price
1	John Bays and Edward James Jeffry, Portland, Oreg.	Tongue Point	11	$0 79	$19,750	$0 1
2	......do	Bugby's Hole	35	55	13,750	[illegible]
3	James Frainey, 315 Clay street, Portland, Oreg.	Hungry Harbor, Wash	12	64	16,000	7
		Bugby's Quarry	35	84	21,000	1 1
4	Elijah Corbett, Portland, Oreg.	On cars at Point Adams.	......	1 40	35,000	1 3
5	John B. David and William L. Smith, Portland, Oreg.	In corporate limits of Astoria.	7	1 30	32,500	1 3
		At a point 36 miles from Point Adams.	36	1 30	32,500	1 6
6	Brazil Grounds, Portland, Oreg.	Point Adams, Oregon	......	1 45	36,250	1 4
7	Patrick O'Neil, 404 Second street, Portland, Oreg.	Hungry Harbor	12	1 28	32,000	1 4
		do	12½	1 45	36,250	1 5
		Tongue Point	11	1 40	35,000	1 5
8	Vincent Cook, Portland, Oreg.	Bugby's	35	62½	15,625	97
9	J. J. Holland, Portland, Oreg.	Tongue Point	11	94	23,500	1 05
		Oak Point	45	78	19,500	1 23
		Hungry Harbor	12	90	22,500	1 02
10	Charles B. Martin, L. Harting, Astoria, Oreg.	At a point 15 miles from Astoria.	15	1 25	31,250	1 40
11	Elijah Corbett, Portland, Oreg.	Cook's Cannery	28	90	22,500	1 18
12	Oregon Paving and Contract Company, Portland, Oreg.	Astoria, Oreg	7	95	23,750	1 02
		Ellise Point	5	65	16,250	70
		Cathlamet	33	70	17,500	1 03
13	William E. Holmes, Portland, Oreg.	Bugby's Hole	35	48	12,000	83
14	James Neal, Saint Lawrence Hotel, Portland, Oreg.	Tongue Point	11	82½	20,625	13½
*15	Leander Michael, Dayton, Oreg.	Point Adams or Bugby's Hole.	35	65	16,250	65

* Contract awarded.

act of contracts, "Improving mouth of the Columbia River," for year ending July 30, 1885.

ames and residences of contractors.	Date of contract.	Subject of contract.	Remarks.
John F. Steffen, Portland, Oreg.	Feb. 12, 1885	Construction of four sea-going barges 30 by 110 feet, 7 feet depth of hold, at $5,364 each.	Fulfilled April 15, 1885.
Plasidus F. Fallert, Kalama, Wash.	Feb. 14, 1885	Furnishing, delivered at Point Adams in raft secured, 20,000 linear feet, more or less, fir piles, at 6 cents per linear foot, as required, upon ten days' notice.	Expected time of completion Aug. 1, 1885.
Louis W. Holt, Astoria, Oreg.	Feb. 16, 1885	Constructing at Point Adams, Oregon, a wharf 34 by 98 feet, and trestle 240 feet long, for $3,495.	Completed April 8, 1885.
Leander Michael, Dayton, Oreg.	Mar. 5, 1885	Furnishing, delivered at Point Adams on board of United States barges, 25,000 tons, more or less, of stone, at 65 cents per ton, in lots, on ten days' notice, at average monthly rate of 4,000 tons.	Expected time of closing contract Sept. 15, 1885.

COMMERCIAL STATISTICS.

'he mouth of the Columbia is in the collection district of Oregon. The Willamette | Columbia rivers are in the district of Willamette. The nearest port of entry to mouth is Astoria. The nearest light-houses and works of defense are at the en-nce to the river.

'he following refer to the districts of Willamette and Oregon, and were furnished Collectors F. N. Shurtleff and John Hobson.

AMOUNT OF REVENUE COLLECTED.

rtland, for year ending June 30, 1885	$189,481 42
toria, for year ending June 30, 1885	54,492 61
Total	243,974 03

VALUE OF IMPORTS.

ortland, for year ending June 30, 1885	$284,310 31
storia, for year ending June 30, 1885	162,008 00
Total	446,318 31

VALUE OF EXPORTS.

ortland, for year ending June 30, 1885	$4,142,152 52
storia, for year ending June 30, 1885	1,997,313 00
Total	6,139,465 52

Recorded shipping for year ending June 30, 1885.

Ports.	Coastwise.				Foreign.			
	Entrances.		Clearances.		Entrances.		Clearances.	
	No.	*Tonnage.*	*No.*	*Tonnage.*	*No.*	*Tonnage.*	*No.*	*Tonnage.*
Portland	171	206,412	111	148,962	68	62,259	125	121,637
Astoria	208	283,550	190	263,101	46	41,953	54	60,572
Total	379	489,962	301	412,063	114	104,212	179	182,209

New coast and river craft registered at Astoria, 8; tonnage, 222.44.

The above statements include those vessels twice discharging or receiving part cargo at Astoria and Portland, which class is principally made up of the San Francisco passenger steamships and vessels lightering down the river. On the other hand, the lumber fleet, unless bound foreign, the Puget Sound colliers, and the smaller coasting craft are not included in the custom-house statistics.

The principal industries near the port at the mouth of the Columbia are salmon fishing and canning and lumbering.

Columbia River canned-salmon shipments, fiscal year 1884.

[Compiled from Portland Journal of Commerce and Daily Oregonian.]

Destination.	No. of cases.	Value.	Remarks.
San Francisco	115, 811	$849, 141 60	Fresh and salt salmon not included.
East, by rail	321, 600	1, 479, 360 00	Shipments of canned salmon for year 1883 were 652,388 cases, of a value of $3,261,940
Foreign, by sea....	184, 596	532, 730 60	
Total	622, 007	2, 861, 232 20	

Columbia River lumber fleets.

Months.	Number of vessels.		M feet.		Value.	
	*1883–'84.	†1884–'85.	1883–'84.	1884–'85.	1883–'84.	1884–'85.
July	5	9	2, 028	3, 521	$20, 289	$33, 757
August........	3	6	1, 505	2, 049	15, 049	19, 571
September........	8	7	1, 440	2, 924	14, 401	29, 254
October	5	6	2, 209	2, 079	22, 091	21, 326
November	3	5	1, 131	2, 318	11, 308	24, 171
December	8	5	2, 765	2, 810	27, 658	27, 329
January........	4	3	1, 776	1, 565	17, 762	15, 650
February	3	4	1, 289	‡1, 784	15, 619	18, 991
March	5	8	2, 242	2, 962	22, 422	§29, 236
April	7	5	2, 322	2, 281	23, 233	26, 220
May	4	9	1, 789	2 485	17, 893	‖29, 296
June........	3	8	1, 292	2, 473	12, 929	¶31, 272
Total	53	75	21, 788	29, 251	220, 654	306, 075

* All shipments domestic, except one foreign.

† Six shipments foreign.

‡ Exclusive of 2,950 hop-poles.

§ Inclusive of 100,000 lath per regular steamship to San Francisco.

‖ Inclusive of 38,000 feet piling and 30 cords wood; also 25,000 feet lumber per regular steamship to San Francisco.

¶ Inclusive of 36,000 feet piling, 81 cords wood, and 7,000 shingles; also 16,000 feet lumber to San Francisco per regular steamship.

S S 3.

IMPROVEMENT OF ENTRANCE TO COOS BAY, OREGON.

The plan here is to build a half-tide jetty or deflecting dike, about 2,400 feet long, from near Fossil Point, inside of the entrance, on a slightly curved line towards Coos Head, exterior to the entrance, for affording a direct channel of 14 feet depth at mean low water. The original estimate of cost was $600,000. The whole amount appropriated since the adoption of the present plan is $130,000, of which $124,953.48 have been expended thereon.

The approved project for the application of the appropriation of July 5, 1884, was for continuing the low enrockment by the means and in the manner heretofore employed and described in previous reports. Needed preparations were made, which were somewhat extensive, from a year's suspension of operations and damage to the tramways by a winter's seas and drift. Some additional plant was obtained.

Quarrying was begun on August 1, stone-dumping as ballast on inner tracks and raising jetty August 6, and jetty advance September 6. Progress was stopped, from near exhaustion of the appropriation, at end of December.

The enrockment was advanced 72 feet, ganged by the track extension, making the total jetty length measured on its top surface 1,761 feet, or 1,825 feet to the toe of the outer slope, and made up by—

	Feet.
Box-cribs and inshore dump from about high water	695
Timber cribs	650
Enrockment on top	416
End slope	64
Total	1 825

The shoreward part, from timber crib 1, was brought to half-tide height; the enrockment for about 150 feet to average of 2 feet below low water; thence it inclines gradually to 14 feet depth for 280 feet; the toe is 50 feet farther and 61 feet depth. The quantity of rock placed therefor, according to car tally, is 22,500 cubic yards.

For about two months at the end of the working season quarry-sluicing operations were conducted for uncovering ledge rock. Subsequently the property and plant were stored.

An extended examination of jetty condition, channel, and sand-spits was made in June. A progress map based thereon is herewith. A detailed report of operations and of channel and jetty changes by Superintendent R. S. Littlefield is also inclosed.

The effect of the jetty on the channel during the year, beyond a fair stability of position, has not been marked.

The examination results show an increase of bar-channel depth of about 1 foot, and a small continued favorable erosion of the north spit. Last year's amelioration of the shoal above Fearless Rock has continued.

Jetty construction across the deep interior channel is expensive, and a considerable advance of the work, made gradually, is requisite for a radical improvement. The estimate for next year, as it has for past years, includes the cost of stone, dump-scows, hire of a strong tug, expense of advanced foundation-course, and following it by a low dump from land.

With the small balance of funds on hand it is expected to make a detailed survey of the entrance and sea bar, take care of the plant, and quarry sluice to a small extent next winter.

Some vacant lands on Coos Head were set apart by the President for this improvement July 14, 1884, for their stone and timber supply for the work. These tracts are lots 1, 2, and 3, and the southwest quarter of the northwest quarter of section 2; lots 1 and 2, and the southeast quarter of the northeast quarter of section 3, in township 26 south, range 14 west, Willamette meridian.

APPROPRIATIONS.

Act March 3, 1879	$40,000
Act March 3, 1881	30,000
Act August 2, 1882	30,000
Act July 5, 1884	30,000
Total	130,000

Money statement.

July 1, 1884, amount available		$22
Amount appropriated by act approved July 5, 1884		30,000
		30,022
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$25,957 13	
July 1, 1885, outstanding liabilities	306 13	
		26,263
July 1, 1885, amount available		3,758
Amount (estimated) required for completion of existing project		440,000
Amount that can be profitably expended in fiscal year ending June 30, 1887		160,000

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. R. S. LITTLEFIELD, SUPERINTENDENT.

EMPIRE CITY, OREG., *June* 26, 1885.

SIR: Operations for improving the entrance to Coos Bay for the fiscal year were resumed August 1, 1884, the effort during that month, with a small force, being to repair the jetty track, somewhat damaged by the previous winter's storms, re-establish the inshore connection to the quarry, and make a new one by a branch track.

The piles for jetty and track extension were driven, as heretofore, into the advanced slope of the enrockment, as occasion required, by the endward fill, the track-driver of last year being used for the purpose.

Piles were cut on the Government reserved land and rafted over.

To suspension of work on the jetty proper, December 31, an advance of 72 feet was made, gauging by track extension The measurement on the sea bottom from the toe of the slope of the previous year to the toe of the present slope is, however, 100 feet.

The extension made in 1883–1884 was low, being 12 to 18 feet below low-water surface. This was built up to average 4 feet below low water, and the present extension carried to the same height, in depths of 42 to 52 feet, the forward slope being in yet deeper water; 21,076 cubic yards of stone were used to form this extension and the fill, together with some portion used on the earlier part of the enrockment to strengthen the piling, which was somewhat shaken by the winter's storms; 1,424 cubic yards were used ballasting tracks at shore, connecting the main jetty track with tracks in the quarry. The total output from the quarry was 22,500 cubic yards.

Sluicing operations were resumed in December, and with a small force continued to the fore part of February, when the force was discharged, except the overseer and watchman, who worked the water all it was possible. During the time of having the water and the force an aggregate of 12,306 cubic yards of earth was removed, and an extension of the ditch above the upper dam made of 43 rods.

Ditches leading into the main dam are now 174 rods long, and have been made, little by little, at times when the supply of water was short during the past three winters. A ditch leads from the dam 13 rods; thence the water passes through a tunnel 82 feet to the bluff.

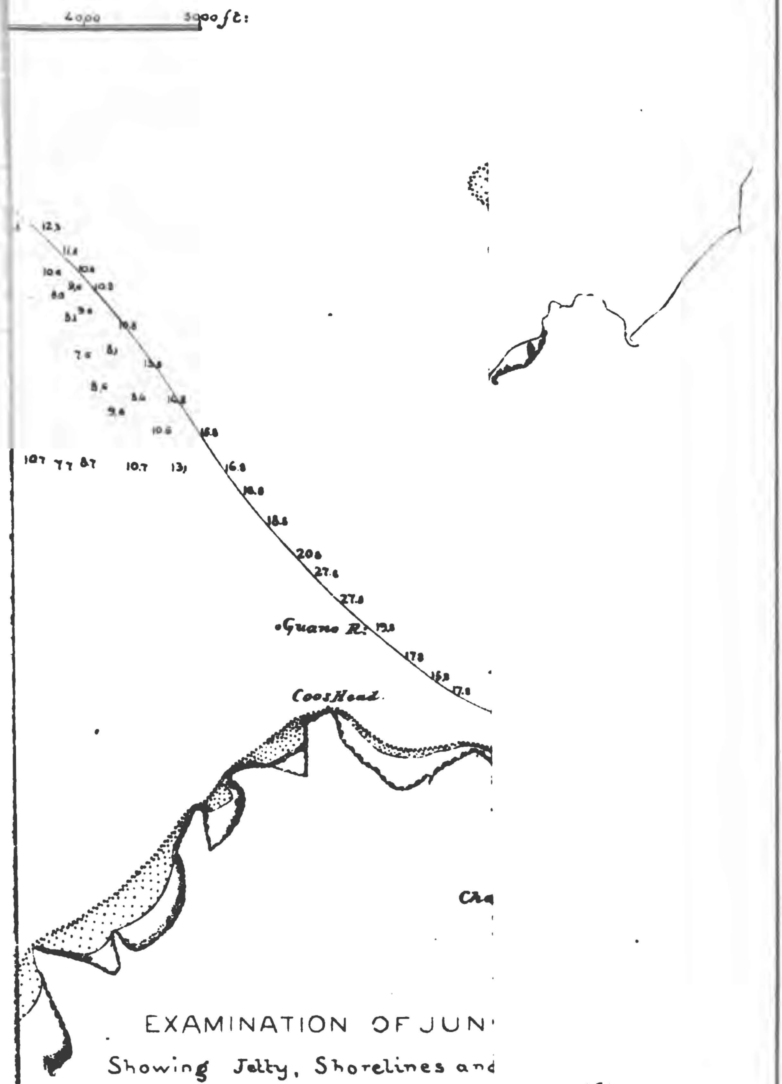
I respectfully forward in another package Coos Bay tracing and profile sheet, with the shore lines of the spit opposite on the tracing, and showing the advance made by the deposit at Coos Heads from erosion of the north spit.

Referring to the profile, although the depths in advance have increased, yet their limit is 100 feet ahead of the toe of the slope formed by the rock. Back of this limit is a measurable deposit of sand made since last January. The sand evidently comes from the up-stream side, as indicated by some of the cross-section outlines. From a hole or trench 43 feet from the center of the dump the ground abruptly rises. There is some deposit on the down stream side, but it is far greater on the side up-stream. To be certain it was sand alone, I dragged a long pole with an iron rod lashed to it 50 feet along from the central line of the dump, as near as could be estimated, by judging distances from the outer line of plumb-bobs suspended at crib 13, without touching a single rock. At the time the large cribs were sunk, this area, as was found in handling anchors, was rough rock bottom. Therefore it seems demonstrated that a deposit of sand forms on the up-stream side of the enrockment proportionably with extension made, and that in process of building up, some portion is carried ahead of the work by the currents.

Another thing: The deepest water in advance was, a year or two since, below or to

S BAY.

wer low water.
. . . . . 5.0 ft.



EXAMINATION OF JUN

Showing Jetty, Shorelines and

report 1885.

Low water outlines of spits 1.2 feet be
for soundings.

F. Powell
Captain of Engineers.

the southward of the line of the work; now it is dead ahead. The present position of the swirl, where this deep water is made by the strong currents of ebb tides, is indicative that by the effect of another extension it will pass above the line of the work or out of existence altogether. I took soundings here on high-water slack to note if there were any fill by flood tides, finding none. It is evident the hole will exist somewhere in advance of the jetty until such time as the ebb tides discharge in a straighter course, which will result with the shortening to some further extent the north spit, the change of which during the year is noticeable.

The total length of the work from jetty track end to the high-water mark at the beach was, at suspension of operations, 1,761 feet; the encroachment from Crib 13 being 416 feet.

Some disturbances to the track, due to the giving way of the side timbers (up-stream courses) of the large cribs, occurred in December, and since that date, in last winter's storms, 32 feet of the jetty piling, with track at outer end, went. The piling on the large cribs is greatly dilapidated, due to the displacement of the stone filling, which has passed freely through openings at the sides—in cases on both sides—made by marine worms, so that practically the track is half gone from off these cribs. The parts above low water in two places take on a slight motion in flood tides, and it may be predicted that some of the tops will be separated during storm tides of the coming winter.

From the earlier date of the effect noticed, the ravages of the worms seem to be most extensive on the up-stream side, or when more intimately in connection with fresh water. Bearing on this subject, I would mention that the worm has appeared with destructive effect in logs in the boom at North Bend, 8 miles up the bay from this point, where they were never observed before. The same is true at the Empire City Mill boom. I would respectfully suggest that the reason for this is that the permanent line or head of salt water has advanced further up the bay than formerly, due to the entrance being less obstructed, for if accounted for by the absence of freshets the past two years, it is suggested that since lumber has been cut here, some thirty years back, there must naturally also have been consecutive years of dry seasons.

I have sought information as to how far up the bay ravages of worms have been noticed, and learn, the information being derived from Mr. C. H. Merchant, "that the teredo is not felt or even noticed particularly above the mouth of Coos River; but below that point they are, and are discovered in the saw-logs as well as the piling. This information is corroborated by the raftsmen."

The mouth of Coos River meant is that just opposite Marshfield Point, on the Coast Survey chart, 1865, or below the town of Marshfield.

Mr. W. P. Metcalf says: "Logs in the boom at Empire are affected after ten months' time."

The sea-bar channel, from a temporary more southerly position (October and November) than it has taken since commencement of operations, changed in December to a more southerly course than last year; still it is not far enough north to lose its designation as a southelry channel.

All work has been done by hired labor, and I would hereby certify to the general interest in their work manifested by the employés, and to the very efficient services rendered by Owen Short and T. C. Porter, respectively overseer and time-keeper.

Respectfully submitted.

R. S. LITTLEFIELD,
Superintendent.

Capt. CHARLES F. POWELL,
Corps of Engineers.

COMMERCIAL STATISTICS.

Coos Bay is in the collection district of Southern Oregon. Empire City, on the bay, is the port of entry. The nearest light-house is at Cape Arago, on the south side of the entrance.

The following are for the year ending June 30, 1885, and were furnished by Morton Tower, deputy collector:

Items.	No.	Designation.	Quantity.
Coastwise entrances	152	Registered tonnage	39, 568. 09
Coastwise clearances	155	do	39, 882. 67
Foreign entrances	3		Ballast.

EXPORTS FROM COOS BAY.

Lumber	feet	17,500,000
Laths	number	2,500,000
Stave and match wood	cords	2,500
Coal	tons	29,000

VESSELS LAUNCHED.

1 schooner, registered tonnage about	600
1 steam vessel, registered tonnage about	25

Record of vessel-crossings.

[Compiled from weekly vessel reports.]

Draught.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Total.
1881–'82.													
Less than 10 feet	8	9	8	6	9	8	7	9	8	11	4	4	91
10 to 11 feet	2	1	2	1	4	2	2	3	3	1	3	1	25
11 to 12 feet	......	......	....	1	2	3	......	3	1	......	2	1	13
12 to 13 feet	3	5	8	10	5	8	6	7	3	5	5	6	71
More than 13 feet	2	1	1	2	2	2	2	3	1	3	3	2	24
Total	15	16	19	20	22	23	17	25	16	20	17	14	224
1882–'83.													
Less than 10 feet	3	12	9	7	9	22	5	8	9	24	12	12	132
10 to 11 feet	1	1	4	4	5	8	2	2	2	2	2	4	37
11 to 12 feet	1	1	2	1	......	2	1	1	1	1	2	1	14
12 to 13 feet	4	8	5	4	5	6	4	5	8	7	13	6	75
More than 13 feet	4	3	2	5	5	......	12	4	4	3	2	2	46
Total	13	25	22	21	24	38	24	20	24	37	31	25	304
1883–'84.													
Less than 10 feet	6	13	13	14	20	16	14	10	10	9	8	11	144
10 to 11 feet	1	4	3	1	......	2	1	1	......	2	2	2	19
11 to 12 feet	1	1	1	......	......	1	2	3	...	2	2	2	15
12 to 13 feet	9	4	6	11	10	7	5	5	1	3	4	4	69
More than 13 feet	5	4	5	4	1	7	6	7	7	3	8	7	64
Total	22	26	28	30	31	33	28	26	18	19	24	26	311
1884–'85.													
Less than 10 feet	7	6	10	3	8	11	9	10	8	6	9	10	97
10 to 11 feet	4	1	1	8	6	4	4	6	6	6	2	5	53
11 to 12 feet	1	...	2	2	3	......	4	6	6	5	1	1	31
12 to 13 feet	3	3	4	2	3	4	2	3	2	4	2	2	34
More than 13 feet	6	4	5	3	8	6	5	5	3	7	5	7	64
Total	21	14	22	18	28	25	24	30	25	28	19	25	279

COMMERCIAL STATEMENT BY MR. MORTON TOWER, DEPUTY COLLECTOR.

CUSTOM-HOUSE, COOS BAY, OREGON,
Collector's Office, July 21, 1885.

SIR: * * * During the past fiscal year the steamer Alki has been built at Bath, Me., for this port, where she is enrolled. Her tonnage is, gross, 943.16; net, 572.03. The Newport Coal Company have built the new steel steamer Arago especially for the coal trade of this port. Tonnage, gross, 827.54; net, 620.06. This is the first steamer built of iron or steel on the Pacific coast.

The steamers Coos Bay and Arcata also make regular trips to this port. The Newport Coal Company are enlarging their works, and during the next year will reopen the Eastport coal mine.

The Henryville coal mine is being opened. The Oregon Southern Improvement Company have completed their mill and at present are running one-half of mill, and when running complete will be able to furnish 150,000 per day.

There are at present time six mills on the bay, viz, two stave mills (one shut down) and four saw-mills running.

Coos River and its bars should be improved and obstructions removed from the mouth of Coos River. At the junction of the forks is a dangerous lodgment of drift, which has repeatedly snagged steamers. On the South Fork there are five bars, which, with small expense, could be removed. The North Fork of Coos River is about the same. By removing these obstructions any bay steamers could run to head of tide-water, 30 miles from the mouth of Coos River, without danger. The logging camps about the bay depend a great deal on Coos River for their hay, and the people generally for their fruit and vegetables.

There are at present three small steamers running to Coos River, with following tonnage, viz:

Name.	Gross tonnage.	Net tonnage.
Bertha	12.81	11.39
Wasp	3.75	2.50
Lula	3.75	2.50

Were the river improved the other steamers could navigate it, as follows, viz:

Name.	Gross tonnage.	Net tonnage.
Comet	58.74	42.53
Myrtle	20.34	13.23
Coos	53.34	44.66
Satellite (laid up)	104.55	....

Very respectfully,

MORTON TOWER,
Deputy Collector.

S S 4.

IMPROVEMENT OF ENTRANCE TO YAQUINA BAY, OREGON.

The project of this improvement is to build a brush and stone jetty to high tide, about 4,000 feet long, on the south side of the entrance, to close the rock-obstructed channel and force the ebb against the reef of Yaquina Head, for providing a central free channel of least depth of 12 feet at mean low water. A shore protection at the heel of the jetty on the north side was contemplated. A shorter jetty from the north reef approaching the adapted work to about 1,000 feet was proposed for future consideration.

The total appropriation commencing with the year of the adoption of the present project is $160,000; the total amount expended thereon is $152,247.41. The original estimate of cost is $465,000.

To the beginning of the year 2,042 feet of jetty had been built, having been pushed out as far as practicable on a weaker profile than ultimately intended in order to speedily force the channel away from the south rocks. The shore protection was omitted in the beginning for the same reason. The omission was continued as the first, and then the second winter following did not show any urgent need of the protection. Heavy surf during storms of the third winter, however, lapping more and more around the jetty end, carried away over 300 feet of the land track and leveled the sand-bank of that part of the point to a beach slope.

Moreover, heavy drift set afloat in railroad grading up the bay and river had considerably disrupted the jetty tramway. Previously there had been no special damage from drift.

In resuming operations under the new appropriation the approved plan was to close the land gap by jetty construction: built a spur northward for protection of the banks, behind which laid our land tracks and storage platforms, heavily strengthen the jetty with larger rock, using any balance which might remain for extension.

The piling of the old tramway was made somewhat light and low for its exposure, and in a desire to effect a present economy and maximum length of jetty. In rebuilding, heavier piles were to be used and the track raised to a level from the wharf, on the bay, making it 5½ feet higher than before at the jetty shore end, or 21½ feet above mean low water. As the water-jet would not be available for pile driving through the mattress work and stone covering, a substantial pile-driving car with a swinging platform was built for similar use, and after the experience of the one at the Coos Bay improvement. The piling apparatus is a drop-hammer one, operated by a Lidgerwood engine.

Cast-iron pile points were used and stone moved for piercing the old jetty. Beyond the mattress the water-jet was again utilized.

The plant was otherwise increased and repaired, and after needed preparations from a year's suspension of operations, construction was resumed in early September, curtailed about mid-winter time, and stopped June 10, when the plant was withdrawn and laid up for another suspension of work.

The jetty, now brought to average height of high tide by heavy riprap, measures 2,517 feet, as follows:

	Feet.
Land gap closure	375
Old works	2,042
Advance	100

The spur-jetty for shore protection is 450 feet long; 540 cords of fascines and about 13,000 tons of stone were used in the works. One employé was accidentally killed. A loaded car jumped the track, throwing the driver and mule off the jetty tramway, also killing a mule.

The work is left in excellent condition and will probably be ready for a speedy extension of the jetty when funds permit.

The want of a lighter-draught tow-boat than the United States tug Wright, and a tramway locomotive, were experienced last year.

The estimates provide for these and other betterments and a completion of the present project in two years. The balance of funds on hand will only permit necessary care of the plant for a year, part of which is floating property, and some desirable observations of the jetty under action of heavy seas, and examinations of it and the channel next May.

A progress report giving details of work by Assistant Engineer J. S. Polhemus is submitted.

A complete survey of the bar and entrance was made in June, with borings on the bar to show the elevation of the underlying ledge rock within otherwise available channel limits, and with careful examination of the outer reef for a navigation pass. The rock does not appear to be higher than about 18 feet at the plane of reduction for soundings, interfering in nowise with the projected channel depth. No break in the outer reef for a wide channel-way exists, so that about the present alignment of the jetty should be maintained for favoring a southerly sailing course to and from the entrance.

A progress map, reduced from the plot of the new survey, is herewith. It shows the sand fill on the south side of the jetty inclosing the south ocks, and 9 feet at low water as in the better channel over the bar; his depth, while an increase over the natural one, is a decrease from hat existing a year ago.

The main channel is a little more southerly and the north one somewhat wider and perhaps deeper than a year ago. Compared with the survey of 1880, before the improvement was undertaken, there is a small general movement seaward of the sands, and a shifting of the Middle Sands from a north and south position to one parallel to the jetty. The bar crossings have not moved west. These changes, on the whole, are considered favorable for the improvement.

APPROPRIATIONS.

Act June 14, 1880	$40,000
Act March 3, 1881	10,000
Act August 2, 1882	60,000
Act July 5, 1884	50,000
Total	160,000

Money statement.

July 1, 1884, amount available		$9 99
Amount deposited		5 00
Amount appropriated by act approved July 5, 1884		50,000 00
		50,014 99
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$45,569 27	
July 1, 1885, outstanding liabilities	265 00	
		45,834 27
July 1, 1885, amount available		4,180 72
Amount (estimated) required for completion of existing project		305,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		160,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. J. S. POLHEMUS, ASSISTANT ENGINEER.

NEWPORT, OREG., *June* 30, 1885.

SIR: I have the honor to submit the following report of operations on the work of improving the entrance to Yaquina Bay, Oregon, for the year ending June 30, 1885.

Active operations were commenced August 7, 1884, by reopening the old stone-quarry belonging to Mr. Cannon.

The six stone-scows were towed from their winter moorings on Ollalie Slough, and one after another hauled out and thoroughly repaired and calked.

* * * * * * *

It was decided to commence at the wharf and run the track-level throughout the whole length.

A pile driver was designed, which turns upon a center and was able to drive a bent 20 feet in advance. It was supported on four of the old car-trucks, and had a hammer of 2,000 pounds.

The engine and boiler acted as a counterpoise to gins and hammer. It could revolve completely around and proved a great success. It was completed early in October; 717 piles were driven with it; besides this, 288 piles were pumped or wiggled down into the sand, making the total number of piles driven 1,005, including those in the spur for shore protection.

In the main tramway the piles were driven in bents of three, 9 feet apart, and capped with timbers 6 inches by 8 inches by 16 feet long, and bolted with three-fourths inch iron; on these rested 6-inch by 8-inch stringers for track, planked between with 3-inch lumber for roadway for mules. There are two tracks to the end, laid 9 feet apart between middles, and several switches connecting them.

The elevation of rail above mean lower low water is about 21½ feet, and the track is level throughout its entire length.

When work was commenced last summer the sea had washed the sand away around the shore end of jetty, destroying the track and extending the high-water mark for over 300 feet from the end of the old jetty.

It was necessary to close this gap with some strong work, as the sand had been greatly washed away from north side of jetty, and the force of the seas about this place was considerable: consequently 316 feet of jetty had to be built from the inner end of old jetty shoreward. It was constructed in all respects similar to old work, as the waves were continually washing away the sand-bank and threatening to go around the head of the jetty again and destroy our track. A spur shore protection was extended 450 feet long from shore end of jetty northwards. It was of like construction as the main jetty except it had only a single track and the tramway is much less substantial.

It has a brush mattress foundation, and quite a high ridge of rock to prevent the wash of the sea from sluicing down the bank during high tides.

After the tramway was rebuilt, and the shoreward extension and spur completed, the old jetty was riprapped on the north side along its entire length.

After the completion of the above works only sufficient funds remained to extend the jetty seaward 100 feet, making the total length of jetty 2,517 feet, not including spur. Its construction is similar in all respects to the old work. Piles were driven or pumped down into the sandy bottom 11 to 12 feet. Brush mattresses were built on suspended grillages and sunk about them. These mattresses extended 20 feet on each side of middle, and were thoroughly ballasted with heavy stone. Over eight scow-loads were consumed in this 100 feet, as for the greater part of its length the water was from 12 to 14 feet deep at mean lower low water. At the extreme end the water was about 2 feet deep, and immediately in front was a narrow sand-spit, bare at extreme tides.

Since July, 1884, there was consumed in the work 540 cords of brush, made into fascines by hired labor.

Sixty scow-loads of stone, averaging 218 tons to scow, equals 13,080 tons, were quarried, towed down, and placed upon jetty, all by hired labor. To quarry this, 105 kegs of black powder and 2 cases of giant powder were used. The largest pieces put in the work were about 40 cubic feet, and would weigh over 2¼ tons.

The steamer Wright has been used for towing, &c., since about the middle of last August.

Active operations closed June 10, and by the 15th the scows were moored away for winter, and all the Government property stored away.

According to your instructions a survey was then commenced of the entrance and outer reef; also a series of borings were made to ascertain the depth of sand overlying the rocky reef under the bar; 47 such borings were made. A thorough hydrographic survey has been made of the entrance.

The steamer Wright was used for the purpose, and located with sextant; 4,500 soundings were taken, and a field chart has been made.

The borings were taken from the tug, which was anchored on the bar and its position located. A hose, leading from our No. 4 Blake pump, was attached to a piece of 1½-inch steam-pipe, which was pushed down until rock or gravel was struck, or a depth of over 30 feet reached. The results are shown on the field chart, and it is found that the rock would not at all interfere with any reasonable depth across the bar.

Very respectfully, your obedient servant,

J. S. POLHEMUS,
Assistant Engineer.

Capt. CHAS. F. POWELL,
Corps of Engineers.

COMMERCIAL STATISTICS.

Yaquina Bay is in the collection district of Yaquina; Newport is the port of entry. The nearest light-house is on Cape Foulweather, 4½ miles north of the entrance.

The following, furnished by Mr. Col. Van Cleve, collector of customs, are for the year ending June 30, 1885:

Revenue collected	$83,814 46
Value of imports	144,750 62
Coastwise entrances ... number	44
Coastwise clearances ... do	42
Registered tonnage	13,190.60
Cargoes reported ... tons	8,234

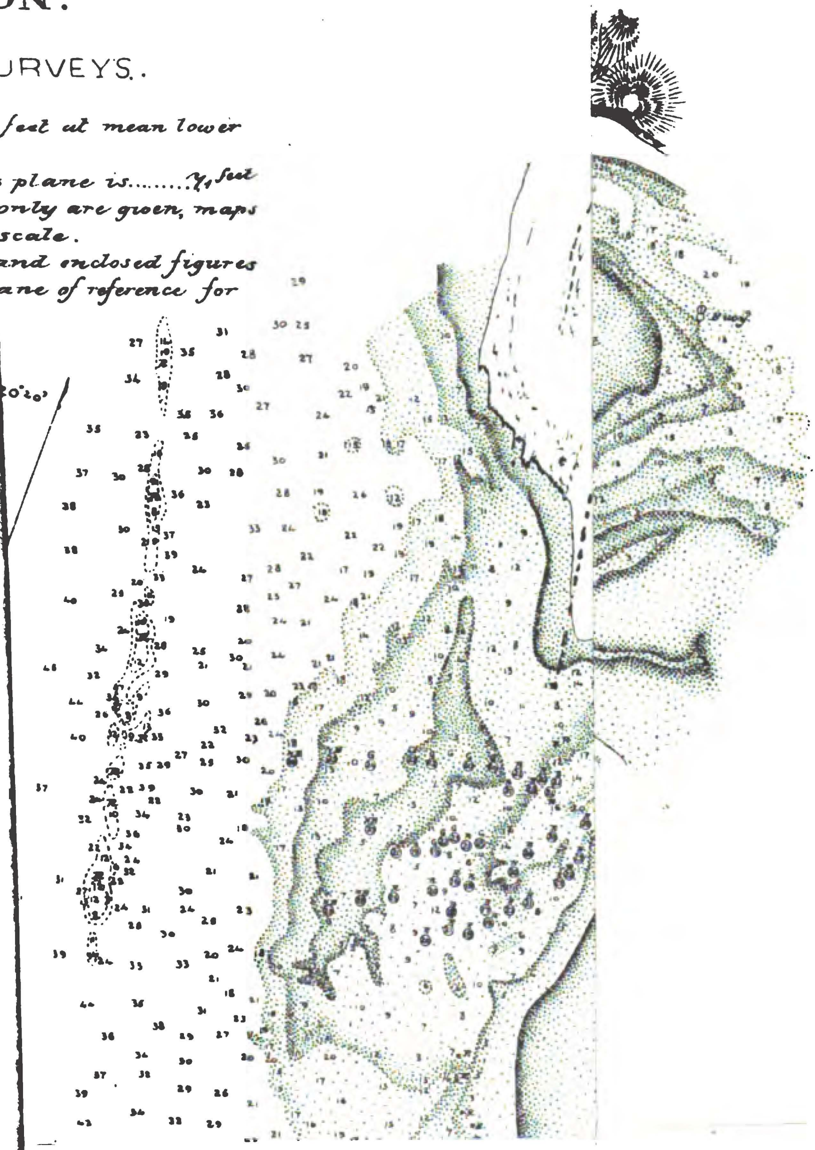
AQUINA BAY.

ON.

URVEYS..

feet at mean lower

s plane is........7, feet
only are given, maps
scale.
and enclosed figures
ane of reference for



Records of vessel-crossings and shipments.

[Compiled from weekly vessel reports.]

Draught.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
1882–'83.													
Less than 7 feet..	4	1	2	......	1	...	......	......	.....	.....	1	2	11
7 to 8 feet	......	......	1	2	1	2	1	.....	.....	3	2	1	13
8 to 10 feet	.....	1	1	......	3	1	1	3	3	2	4	......	19
10 to 12 feet	......	1	......	......	......	......	......	......	......	......	2	2	5
More than 12 feet.	......	......	......	......	......	......	......	......	......	..	......	1	1
Total	4	3	4	2	5	3	2	3	3	5	9	6	49
1883–'84.													
Less than 7 feet..	......	3	1	1	1	1	1	1	5	1	3	5	23
7 to 8 feet	4	......	......	......	......	1	2	2	2	3	1	......	15
8 to 10 feet	......	1	1	......	......	......	......	......	......	1	......	4	7
10 to 12 feet	......	......	......	......	......	......	.. ..	......	3	1	1	......	5
More than 12 feet.	......	.....	......	....	...	......	......	......	......	......	......	1	1
Total....	4	4	2	1	1	2	3	3	10	6	5	10	51
1884–'85.													
Less than 7 feet..	3	3	5	2	1	1	......	......	3	......	3	6	27
7 to 8 feet	2	3	1	......	3	... ..	1	......	1	......	1	2	14
8 to 10 feet	3	6	3	4	4	1	3	......	1	......	1	......	26
10 to 12 feet	2	1	2	11	1	1	......	2	2	......	1	......	23
More than 12 feet.	......	......	1	2	2	......	......	......	......	......	......	......	5
Total.........	10	13	12	19	11	3	4	2	7	......	6	8	95

Exports.—One cargo wool and 100 tons wheat.

Imports.—Merchandise, 2,455 tons in twenty-seven cargoes; railroad iron and supplies, 7,120 tons in twelve cargoes; lumber, 210,350 feet in five lots; shingles, 86,000 in two lots. Six vessels in the general trade and eight vessels brought railroad materials.

A railroad from the bay to Corvallis in the Willamette Valley, 72 miles long, was completed during the year.

STATEMENT BY MESSRS. R. A. BENSELL AND J. W. BRASSFIELD.

NEWPORT, OREG., *July* 8, 1885.

SIR: * * * It is a very difficult matter to obtain any accurate figures of the imports and exports of this harbor, as a large amount of merchandise imported is never given to our collector of customs, and there is no particular register kept of exports. Therefore, we will have to give them from our personal knowledge of the business done here.

First, we will give you statistics as registered and furnished by Mr. Coll. Van Cleve, collector of customs, pertaining to Yaquina Bay and tributaries for year ending June 30, 1885:

* * * * * * *

Imports in excess of reports to collector	$72,000
Excess tonnage on entrances not reported to collector .... tons..	1,000

Exports from this port as yet are somewhat limited, but we notice a large increase over previous year. Wool, hides, furs, hoop poles, and cherry-poles have been the principal exports, of the value of which it is hard to get a correct estimate. Dairy products have commenced to swell our exports, and will increase largely as the country improves in this direction. The Government plots of the townships lying along and north and south of Yaquina Bay and River show but little land untaken by actual settlers. The completion of the Oregon Pacific Railroad has given impetus to emigration, and the country tributary to Yaquina has rapidly settled within the last year. Closely connected with the beneficial results certain to follow the operation of the railroad is the development of large natural resources which, for want of cheap and accessible markets, has heretofore remained idle. Former reports in your office illustrate the advantage to be derived by the agricultural counties of Linn, Lane, and Benton, and portions of Polk and Marion, a territory equal in area to some of our smaller States. The importance of this subject has been so often and well represented by petitions, memorials, and reports commanding the highest respect, that we will not attempt to add anything to the weight they deserve.

All the benefits foreshowed are largely contingent on the improvement of the bar. The economical expenditure of moneys already appropriated and the excellent results therefrom only intensify the public demand and increases the intent of all classes to have work pushed to an early successful completion.

Very respectfully,

R. A. BENSELL.
JAMES W. BRASSFIELD.

Capt. CHAS. F. POWELL,
Corps of Engineers.

S S 5.

IMPROVEMENT OF THE MOUTH OF COQUILLE RIVER, OREGON.

The approved project is for a channel through the north cape of the entrance, 10 feet deep at mean lower low water, by a half-tide jetty on deflecting dikes about 3,400 feet long, built from the left bank, and passing 800 feet south of the Rackliff Rock. The original estimate of cost is $164,200. The total appropriation commencing with the year of adoption of the project is $30,000.

The amount expended thereon is $27,455.28. No operations had been conducted during the year 1884. The last work was suspended March, 1883. To that time a low, attenuated jetty of a total length of 1,365 feet, the last 312 feet of which consisted of track-piling without ballast, and made for a special purpose, as explained in the report for 1884, had caused the radical change in the entrance designed by the project. The natural channel had been filled to above high water, and a new entrance cut through the north cape.

The improved channel was straight, direct, and free from rocks, and had a depth June, 1883, of 7 feet at low tide, or about double that of the old channel.

The situation a year later was that nearly all of the *temporary* jetty-work had been disrupted by sea and drift, and the adjacent fill had disappeared, a portion of the outflow escaped uselessly to the south among the rocks, and the channel depths had been diminished by 2 feet. In applying the small appropriation, $10,000, of the act of July 5, 1884, which was for continuing a jetty projected into the open ocean, the object sought was to extend the work for flanking the Spindle Rocks before winter and yet make a construction of a fair permanence.

The plan approved was to build a compartment structure of close piling without any present stone filling, but waled on the inside below the top and having longitudinal walls tied together at the top, reserving a balance of funds for subsequent use.

Accordingly a pile-driving car, patterned after the one used on the Coos Bay work, was constructed, hoisting engine and drop-hammer apparatus hired, and piles ordered upon bids after public notice.

An agreement already existed for sawing and delivering timber from logs owned by the improvement.

Operations were commenced in late August and closed in January; 442 feet of structure were built, commencing 1,061 feet from the land end of jetty. The side walls are 6 feet between middles, and the cross rows at 20 feet intervals. The inside waling is 4 feet from the top of the piles. The track stringers rest on the ties, which are framed into he top waling. The track is level and about 15 feet above mean low ater.

There was a small natural fill in the compartments which was suplemented by a made fill of brush and sacked gravel. Small wings of he same material were placed on part of the south side to check an in-ipient scour.

A deflection of the southward outflow was noticed in October and better channel depths were reported by January.

Operations were resumed in March with the object of riprapping the head of the jetty, stone-ballasting the compartments and a section of the open piling shoreward from the close piling. A tramway was built at jetty track leveled over the extensive south fill and around the lagoon to a large rock mass 700 feet distant.

Besides some ballasting of the sills of the tramway bents on the edge of the lagoon, 860 cubic yards of stone were quarried and placed in jetty. The sea-end dump made a practical extension at low-tide level of 20 feet, so that the total jetty length is 1,523 feet.

Additional waling timbers were bolted to the close piling, where the piles were not on alignment, and the rock near the channel's edge abreast of the jetty was drilled and plugged for blasting in case the adjacent shore line retreated.

A progress report by Mr. R. S. Littlefield, superintendent, and a map in two parts showing changes are submitted herewith.

The satisfactory improvement effected at the mouth of the Coquille River and maintained practically for over two years by reducing its vessel insurance rates and freight charges, has been of marked benefit to the traffic of the Coquille Valley.

The work of improvement needs to be solidified and extended, and a short work added on the north side of the entrance; the amount estimated for next year is for application to that end. The balance on hand will hardly suffice for taking care of the property and making desirable observations of the jetty.

APPROPRIATIONS.

Act July 14, 1880	$10,000
Act August 2, 1882	10,000
Act July 5, 1884	10,000
	30,000

Money statement.

July 1, 1884, amount available		$10 13
Amount appropriated by act approved July 5, 1884		10,000 00
		10,010 13
July 1. 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,371 13	
July 1, 1885, outstanding liabilities	309 19	
		9,680 32
July 1, 1885, amount available		329 81

Amount (estimated) required for completion of existing project	134,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	75,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. R. S. LITTLEFIELD, SUPERINTENDENT.

EMPIRE CITY, OREG., *June 29, 1885.*

SIR: The project adopted by you, the season of 1884, for continuing the work of improvement at entrance to Coquille River, was to make extension of the permanent jetty there, put in in 1882 and 1883, by a double row of close piling, divided into compartments by cross rows every 20 feet; the same to remain unfilled, except as an expected deposit might tend to fill with the works advancement, deferring till spring the use of stone either for riprap or as filling; the piles to be cut off at a grade 3 feet higher than the former jetty track was, and strongly bonded together by 8 by 8 inch timbers, drift-bolted to their tops, into which timbers cross-ties of same dimensions should be dovetailed every 5 feet; fastened to these were to be stringer-pieces 6 by 6 inches for a track for a pile-driver. The compartments were to be further strengthened by inside wale-pieces screw-bolted to the piles. * * * With hire of pile-driving machinery piles gotten out by contract, the execution of the work was to be by hired labor.

The month of August was taken up in getting requisite materials together and the construction of a track-driver, after the plan of the one in use at Coos Bay.

From September to December, inclusive, the piling was pushed forward steadily and with good progress, considering the hardness of the material to drive into, and that during flood tides the piles had to be hoisted from the surf. An advance of 442 feet was made, the work crossing the 5-foot low-water channel, running south, filling it with deposit which about kept pace with the piling progress; brush was used, ballasted with sand bags, to thoroughly check the flow.

The piles at first had a penetration of 10 to 14 feet, so that all the accretion tended to strengthen them. A double row of piling was driven at outer end of work and well fastened, forming a bulkhead to resist drift.

Your anticipation that the work would fill by deposit, during progress, to low water and above, was fully realized; and it stood the winter storms and drift brought against it without damage. Early in January the channel over the bar recovered its former depth. Before this happened the turn just inside the entrance straightened and deepened so that at temporary suspension of operations good results had been obtained, both outside and in.

Work was resumed March 19, the purpose being to fill with stone the outer compartments from the slope of the beach at high water; to use some rock for riprapping at outer end, and to fill to the height of the track a section of 52 feet length shoreward from the new piling, which space was in advance of the dump made in 1883.

To reach the quarry it was necessary to build 898 feet of track on high and low water part of the spit, and cross the outlet of the lagoon. This was accomplished, at end of the month, and the mud-sills supporting the section crossing the low ground ballasted.

Work was continued until April 25, by which date 924 cubic yards of stone were quarried and delivered, the bulk of which was dumped in the pile compartments and over the outer end, filling a deep hole made at times by the surf there, and forming a mass to the height of low water. The work practically ends at a ledge. The stone piled above low water were thrown on both sides by the surf, in from end, thus riprapping where needed.

I send in another package a tracing showing present shore lines and the general course of the channel, with soundings over the bar.

The area of the lagoon is considerably reduced, due to the fill at lower end at time the breach in the spit was made during a storm in October last.

I would respectfully call attention to faithful services by the employés, and credit J. J. Thompson, overseer, with zealous and efficient supervision last fall; also Owen Short for rapid progress with the work in hand this spring.

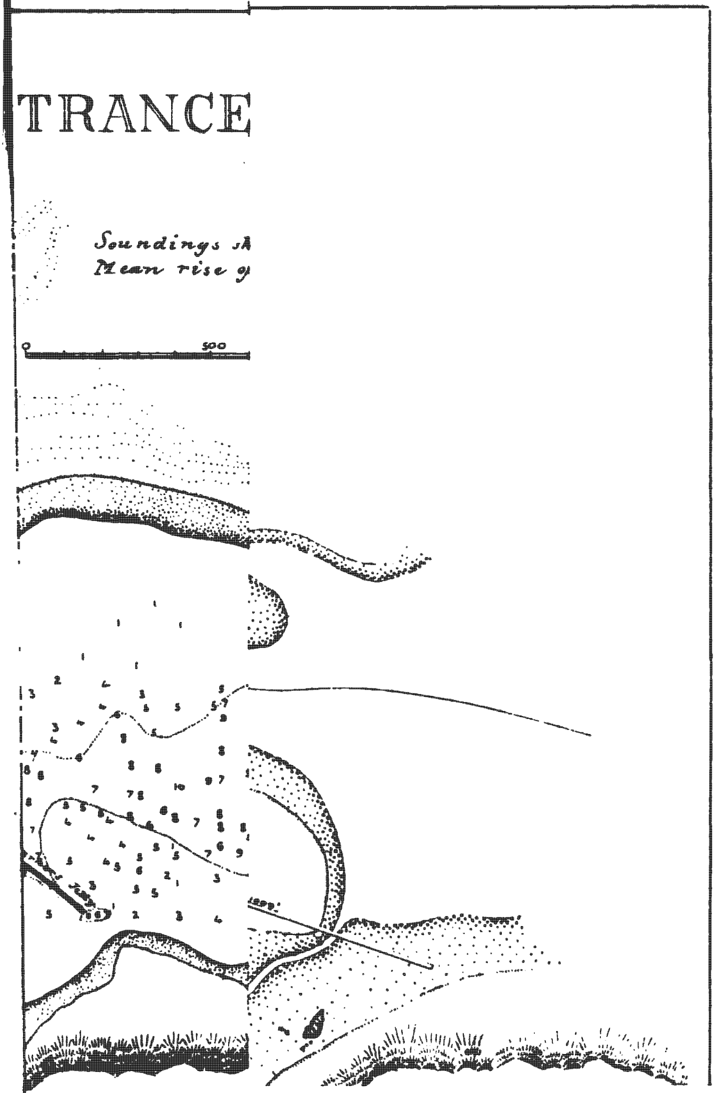
Respectfully submitted.

R. S. LITTLEFIELD,
Superintendent.

Capt. CHAS. F. POWELL,
Corps of Engineers.

COMMERCIAL STATISTICS.

The mouth of the Coquille River is in the collection district of Southern Oregon. Empire City, on Coos Bay is the port of entry. The nearest light-house is on Cape Arago, 12 miles northward.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Soundings sh
Mean rise o
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Record of vessels crossing.

[Compiled from weekly reports.]

Draught.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
1882–'83.													
Not given	6	6	2	4	4	5	3	4	......	......	......	......	34
Less than 7 feet	......	......	......	......	......	......	......	......	......	2	1	3	6
7 to 8 feet	......	......	......	2	......	......	......	1	5	1	4	1	14
8 to 9 feet	......	......	......	......	......	......	......	1	......	......	2	......	3
Total	6	6	2	6	4	5	3	6	5	3	7	4	57
1883–'84.													
Not given	......	......	......	......	......	......	......	......	......	......	......	3	3
Less than 7 feet	3	4	4	2	2	5	5	4	4	1	4	......	38
7 to 8 feet	2	......	2	2	2	5	2	3	1	3	2	......	24
8 to 9 feet	......	......	......	......	......	......	......	2	1	2	1	1	7
Total	5	4	6	4	4	10	7	9	6	6	7	4	72
1884–'85.													
Less than 7 feet	3	2	1	2	1	1	1	......	1	1	2	1	16
7 to 8 feet	2	3	2	......	4	......	......	1	1	......	......	......	13
8 to 9 feet	1	......	1	......	......	......	......	......	1	1	2	2	8
Total	6	5	4	2	5	1	1	1	3	2	4	3	37

EXPORTS, 1884–'85.

Lumber:	
Cargoes	22
Feet	2,975,000
Wool:	
Tons	972
Fish:	
Tons	30
Cases	1,400
Barrels	419
Pork:	
Tons	5
Barrels	49
Butter:	
Tons	13
Chickens:	
Dozen	20
Apples:	
Boxes	475
Hides:	
Tons	6.7
Packages	47

IMPORTS, 1884–'85.

Merchandise:	
Tons	906
Machinery:	
Tons	15

Seven vessels in the trade. Two coasting schooners and a fishing smack built on the river were launched. The Parkersburg saw-mill was rebuilt; ground was cleared for a saw-mill near Bandon. A building up-stream from Parkersburg was erected for a sash and door factory.

The Coquille Valley is productive; its timber is a good quality of fir, white cedar, and myrtle. The upper part of the valley is agricultural. The dairy and grazing region, south half way to Port Orford, finds an outlet at the mouth of the Coquille. The river is navigated by light-draught boats for 40 miles; small coasters ascend to Coquille City, 28 miles.

STATEMENT OF MR. GEORGE BENNETT.

BANDON, OREG., *July* 2, 1885.

SIR: I beg respectfully to draw your attention to the following particulars connected with the produce and resources of that important portion of Southern Oregon through which flows the Coquille River and its numerous tributaries, and also to the great benefits derived by the inhabitants from the improvements already effected at that river's mouth, trusting that in so doing your Department may be induced to place the matter before Congress with a view to procure an appropriation that will be at least sufficient to continue the present jetty out to the deep water.

In addition to our products which pass through Port Bandon and out through our river's mouth, Port Bandon is also the shipping port for that portion of the coast stretching south for about 14 miles, and embracing Floras Creek, New River, and other places already in high repute for the product of their dairies.

Our products are as varied as are to be found anywhere. Inland, corn matures as well as it does in any State in the Union, whilst down here on the coast we grow cucumbers, musk-melons, and citrons—the products of a semi-tropical clime—alongside potatoes, onions, cabbages, cauliflowers—the products of a temperate clime. All these we can produce in profusion, but as we have no market for them we merely grow enough for our own use. We also grow peas, oats, wheat, barley, &c. Our soil here is mostly a sandy loam, containing about 75 per cent. of silica, and our varied productions are, as we believe, to a great extent, due to the equability of our climate. The monthly mean of January, our coldest month, is 46 degrees; and that of August, our hottest, is 59, there being only 13 degrees between our mean extremes. We doubt if this can be said of any other portion of the United States. Our butter brings the highest price in San Francisco, being the product of a cool clime, and our beef, pork, and mutton are favorably known.

Our white cedar, myrtle, ash, oak, and pine have attained such a favorable notoriety in the city that we deem comments, in their case, unnecessary. Within the twelve months ending June 30, 1885, there were shipped through Port Bandon 4,550,000 feet of lumber, mostly white cedar and first-class pine. In addition to this there was locally consumed about 2,000,000 feet for ship-building and for the erection of houses, barns, &c., to accommodate our numerous immigrants, many of whom brought with them thoroughbred cattle and good blooded horses.

There were also shipped 450 tons of butter, salmon, wool, hides, &c., and in addition canned salmon and match-wood.

Our imports consisted of 1,248 tons of the ordinary requirements of a civilized community.

As you are aware, the estimate for making the necessary improvements at the mouth of the Coquille is $164,200; of this sum Congress has only given us as yet $30,000, and the benefits arising to us from what has been already accomplished has benefited us very considerably. Before the first pile was driven for the erection of our jetty our imports came to Coos Bay, from thence they went through Isthmus Slough to Aikin's Landing, thence over the Isthmus, thence through Beaver Slough in a row-boat, and from thence in the same hazardous conveyance down the Coquille River to their destination. This cost us from $12 to $14 per ton. Now they come in through our river's mouth for from $4.50 to $5 per ton. On our shipment of lumber, via the river's mouth, we paid $11 per ton. Now we pay only $5.

As you will perceive the difference between the cost of exporting the lumber shipped this year, and it was less than that of last year, owing to the dullness of the lumber market, and that of the exports and imports of this year, compared with what they would cost before the improvements were made, amount to no less than $40,584. Thus, the $30,000 expended by the Government at the mouth of the Coquille, in three years, was paid back to the people in one year, and 35 per cent. over.

Some new enterprises are spoken of here, such as woolen-mills and a beet-root sugar factory. The building for a sash and door factory is erected, to which will be attached a saw-mill. The ground for another large saw-mill within one mile of the river's mouth is already prepared, and we have parties engaged in the deep-sea fishing. The little schooner belonging to one of these which went to sea some weeks since has not yet returned. The others are located at Tonnet Rock Bay, about half a mile at the south side of jetty, from which place they proceed to sea in open boats when the weather permits, and return with cod, sea-bass, rock-cod, gurnet, and halibut; the first of the latter caught weighed 80 pounds. These are put on board one of our river steamers and readily disposed of in the various towns and villages on our river's banks.

Since the expenditure of the last appropriation vessels for the first time venture out at night. The first of those were towed out by Captain Parker a short time since. Since then the Parkersburg went out on the 14th of last month at 2 in the morning, and the Gem on the 24th of last month, near midnight. The latter, in addition to the usual supply of merchandise, took out 210,000 feet of lumber.

I am authorized to state that when the south wall of jetty is completed to the deep water as now sought, a steamer will ply between the Coquille and San Francisco. This will be a great boon to us, as we can then confidently ship perishable articles, such as fresh butter, poultry, vegetables, &c.

When what we require is completed, or even commenced, the enterprise previously mentioned will start into full work, and the residents in this valuable portion of our State will have good reason to gratefully appreciate the solicitude and care of a paternal Government.

I remain, sir, with much respect, yours, very respectfully,

GEORGE BENNETT.

Capt. CHAS. F. POWELL,
Corps of Engineers.

S S 6.

IMPROVEMENT OF SKAGIT, STEILAQUAMISH, NOOTSACK, SNOHOMISH, AND SNOQUALMIE RIVERS, WASHINGTON TERRITORY.

The project consists in annual snagging and moderate bar scraping by a regularly equipped snag-boat for light-draught navigation, on an aggregate length of river of about 250 miles, at an originally estimated cost of $25,000 as the first cost of the boat and $10,000 annually thereafter for her operation. The amount appropriated on this project is $30,000, and the amount expended thereon is $30,212.30.

A contract for a snag-boat had been finished during the previous year. She lacked full completion and some appliances for effective work. The smallness of the appropriation of July 5, 1884, and the urgent need of the boat's service permitted only a meager outfit.

Work by a small boat party had been done in the previous year on the Snohomish River, the one next north of Seattle. The snag-boat was therefore sent to the Steilaquamish August 27, where she removed 34 snags on the part to Florence, 6 miles from the mouth and the head of present desired navigation.

The boat was then transferred to the Skagit, where she worked via Steamboat Slough, the main mouth, to Lyman's, 39 miles, removing, with the aid of explosives, 1,168 snags or pieces of sunken drift and 100 yards of rock. The snags and drift were large and heavy and more or less imbedded in the bottom.

There were two bad drift jams in the Skagit delta, one at the head of the North Fork and the other in Main River, blocking the heads of Deep and Freshwater sloughs. The removal of the former was desired to give a short cut to La Conner, and the latter for prevention of land overflow. Some citizens were at work on the Main River jam who expected the snag-boat to aid them. From an examination of the situation it was deemed proper that the public operations should be confined to the single navigated channel.

After having cleared that as far as steamboats generally desired to run, the snag-boat was sent to Swinomish Slough, a steamboat passage on the route connecting the mouths of the rivers to be improved, where 3 snags were removed. The snag-boat was withdrawn to Seattle December 16, and laid up in the Dwamish River, near the mouth.

For operations on the Nootsack River, where an extensive jam below Nootsack Crossing prevented a desired continuous navigation to the crossing, the experienced land party working on the Chehalis River were transferred to the Nootsack jam in October. A passage 100 feet wide of removed or loosened material was made by sawing, cutting, blasting, log driving, or use of tackle from the lower end of the jam to within 200 yards of the head; 1,124 pieces were loosened, and also a considerable quantity of brush and sand. Part of the drift was driven down-stream.

All operations were suspended at the middle of December, the party disbanded, and property stored.

A contractor's party of four men, under a local citizen's committee, worked on the jam in conjunction with the Government party, stopping in December. It is learned that this party resumed work about last May and completed the passage and are now trying to make a navigable channel through it.

The estimate for next year, based upon experience since commencement of the project, is following:

Completion of snag-boat and outfit	$5,000
Cost of work on five rivers, at $3,000	15,000
Annual reserve for replacement of plant at end of ten years	2,000
	22,000

APPROPRIATIONS.

Act June 14, 1880, Skagit River	$2,500
August 2, 1882, Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie rivers	20,000
Act July 5, 1884	10,000
	32,500

Money statement.

July 1, 1884, amount available		$6 79
Amount received by transfer of property to other improvements		227 94
Amount appropriated by act approved July 5, 1884		10,000 00
		10,234 73
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$10,219 12	
July 1, 1885, outstanding liabilities	15 00	
		10,234 12
July 1, 1885, amount available		61
Amount (estimated) required for 1 year's completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		22,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The rivers are in the collection district of Puget Sound. The nearest port of entry is at Port Townsend, Wash. The revenue collected there during the year ending June 30, 1885, was $48,062.05. The nearest light-houses are on Puget Sound.

The number of new coast, harbor, and river craft registered at Port Townsend during the year was twelve, with a total tonnage of 1,178.74.

The aggregate length of these rivers on which navigation can be readily improved and extended is about 250 miles. In the absence of wagon roads they form the only routes of travel and transportation.

The lower parts of the valleys are adapted to agriculture; in the upper portions are tracts of fine timber and reported veins of coal and iron.

Present industries are logging and farming. Grains, vegetables, hay and dairy products are exported by river steamers to Seattle and other towns on Puget Sound.

The sections tributary to the rivers are growing in population and business.

STATEMENT BY MR. D. O. PEARSON RESPECTING TRAFFIC AND OBSTRUCTIONS ON THE STEILAQUAMISH RIVER.

STANWOOD, WASH., *June* 5, 1885.

SIR: The exports of the Steilaquamish Valley and surrounding country consist mainly of grain and lumber from the flats around the mouth of the Steilaquamish. About 50,000 bushels of oats and 600 or 700 tons of hay are shipped annually. The carrying of the grain and hay is done by light-draught steamers plying between Seattle and the Skagit River, namely, the City of Quincy and the Glide.

There are about 12,000,000 feet of saw-logs cut and towed from the Steilaquamish Valley annually, being towed by small light-draught steamers.

The transportation of grain and hay from the upper river is at present impossible, on account of jams in the river. From the mouth grain costs $1.50 per ton, and hay $2.50, to transport. Near the mouth of the river, at present, are snags and shoal bars, which render it very unsafe for steamers to navigate, and almost impossible to tow logs, and render it very dangerous to a boom of logs, by breaking the chains or spilling.

The snags could be removed for about $2,000.

The cost of towing logs at present is 12½ cents per thousand. If the snags were removed, I think they would be towed for 10 cents per thousand, a saving of 20 per cent., besides the liability of loss in towing.

Respectfully,

D. O. Pearson, P. M.

Capt. Chas. F. Powell,
Corps of Engineers.

S S 7.

IMPROVEMENT OF THE CHEHALIS RIVER, WASHINGTON TERRITORY.

The project consists in annual snagging operations below Claquato, 82 miles from the river's mouth, at an estimated cost of $5,000. The total appropriation since adoption of this plan is $5,500. The amount expended thereon is $5,004.93.

In the previous year a passage had been opened through one of three drift-jams near the Chehalis Indian Reservation, and some work done below to free the river from its mouth to the landing.

Operations under the act of July 5, 1884, were to be applied to the two jams next above the reservation landing in order to make a continous opening down-stream from the stations Chehalis and Centralia on the Northern Pacific Railroad. A party under an experienced man to work from land and small boats commenced August 27, and completed a passage by the middle of October; 1,711 pieces of drift were cut, sawed, blasted, or burned, and loosened where not removed. The party worked down-stream as far as Black River driving and clearing out of the way refuse from the jams.

A copy of a report of a late examination of the river from Chehalis down is attached. It appears that open water exists from above the railroad, with more or less isolated drift obstruction.

It is proposed to use small balance of funds on hand in blasting the worst snags below the Block House, a point between the reservation and Elma.

The amount estimated for next year is the cost of annual work for a channel free of drift obstruction from Claquato down.

APPROPRIATIONS.

Act August 2, 1882	$3,000
Act July 5, 1884	2,500
Total	5,500

Money statement.

July 1, 1884, amount available	$17 56
Amount appropriated by act approved July 5, 1884	2,500 00
Total	2,517 56
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,022 49
July 1, 1885, amount available	495 07

Amount (estimated) required for 1 year's completion of existing project	$5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

REPORT OF RIVER EXAMINATION BY MR. E. H. JEFFERSON, SAILING MASTER.

SEATTLE, WASH., *July* 18, 1885.

SIR: In compliance with your instructions to proceed down the Chehalis River from Chehalis Station to Gray's Harbor, and make an examination of the same I have the honor to report on the duty performed as follows:

On the 11th instant I succeeded in purchasing a 14-foot skiff and engaging a good man to accompany me.

The distance down the river was much greater than I anticipated, and instead of its taking me about one day, as I calculated on, it took me fully three days to Elma. The river is very low, and in portions of it there is no current whatever to help a boat along. It is comparatively dead water, except at the riffles and gravel-bars, of which there are a great number. I passed over 76 of them, on which the depth of water ranged from 3 to 12 and 14 inches; over a great many of them we had to wade and drag the skiff. The deeper ones could be run; but it required skillful management to avoid capsizing by striking bowlders and brush along the shore.

From all accounts, and from my own judgment, I should say that the distance from Chehalis Station to the mouth of the river is about 100 miles. It is over 60 by the wagon road, consequently is much more by the river, as that is very tortuous, winding and turning in every conceivable manner and direction.

On the morning of the 12th instant I started and made the Indian Reservation the same evening; on the evening of the 13th Porter Creek, and on the evening of the 14th Elma, where I was instructed to leave the skiff. I let my man go here, and he walked back to Chehalis. Mr. Abell sent a man with me to Montesano, 12 miles below, where I could take a steamer down the balance of the way to Gray's Harbor, the same man returning with the skiff to Elma.

On the morning of the 15th I took the little mail steamer at Montesano, went down to Hoquiam, and returned the same evening. On the 16th I took the stage at Montesano, arriving at Olympia in the evening, and on the 17th came to Seattle by steamer.

From inquiries concerning the river above Chehalis Station I find that it is navigable, when the river is up, for about 25 miles, and is comparatively free of snags. From Chehalis to Centralia (8 miles) there is a good stretch of river; depth of water from 2 to 20 feet, no current, and no snags to speak of. From a point a few miles below Centralia the riffles and gravel-bars commence and continue at intervals clear down to Elma, and, as a rule, the sections of river between them are dead water—no current to speak of, but over the riffles the water runs very swift.

About one-quarter of a mile below the reservation the old drift-pile or jam commences. I stopped here and gave it a good investigation, making a rough sketch of it, inclosed herewith. The old bed of the river here is completely filled up with drift, saw-logs, and gravel. It is estimated that there are 5,000,000 feet of logs in there. A gang of men are at work getting them out, and, of necessity, are forced to move some of the drift, but I hardly think the river will follow the old bed again, as the "cut-off" is about as wide as the old channel. It is about a mile from the upper end of the drift to the lower end, but it is not continuous; it is in patches.

The banks are lined with trees that have washed in and have caught and hung in places. In some cases the tops reach nearly across the now narrow channel.

There are roots and stumps also deposited along the channel for miles below. I think that Hedges did the most of his work on this "cut-off," as I see evidences of it. * * * A great deal of the drift, where it is in piles or patches, could probably be burned during the dry season.

Between the reservation and Elma (25 or 30 miles) is the worst section of the river; the section that needs the most improvement.

I hardly feel competent to estimate the cost of cleaning the river. I hardly think a gang of men could clean it out good in one season, working only when the water is low.

Some of the farmers living near the river at the old jam think there is danger of another blockade if some more work is not done there. Such a thing may possibly occur, but I think the chances are against it. There are little patches of drift and snags in places clear down to Elma; there is one of considerable consequence 7 miles above that place. From Elma down to Aberdeen, at the mouth of the river, the distance is about 30 miles, and tide-water extends to within a mile or two of Elma.

Just below Mr. Abell's place are a couple of riffles on which there is about 12 inches of water at the present stage; he says if a few of the logs that are embedded in the gravel on those riffles were removed he could navigate from his place down at all times of the year.

Mr. Abell's boat is the only one there at present that pretends to run above Montesano; she makes a trip occasionally up as far as the "Block House," about midway between Elma and the reservation, when the river is up; she is a poor excuse for a steamboat; has deficient boiler power, and is run with a belt connection; her hull is also illy shaped and modeled, having formerly been an oyster plunger.

From Montesano down it is the prettiest river in the Territory; wide and deep, with but four or five snags in it. The little mail steamer (a propeller), drawing 5 feet, can run up at all times of the tide; and at high tide vessels drawing 18 feet can go up.

The river is navigable, on an average, about six months in the year, and during that time I see no *serious* obstructions to navigation. The cry seems to be along the river "if the Government would only clean it out we would have steamboats running on it." The fact is there is no boat there fit for the purpose. * * *

A man at Porter Creek says he has flat-boated goods from up Black River (which empties into the Chehalis about 2 miles below the reservation) down to Gray's Harbor; he has also rafted lumber down from his mill at Porter Creek.

Wheat and other truck are taken down from the "Block House" in canoes at times and logs are run on all parts of the river. There are four county bridges across it; one at Chehalis, one 3 miles, and one 6 miles above, and one at Centralia; they are about 30 or 35 feet above the river at its present stage. There is a grist-mill on the river bank at Centralia and one at Elma, and several saw-mills scattered along from Chehalis down.

Take it upon the whole, I don't think the river is any worse than the Nootsack or the Snoqualmie, as far as snags or drift is concerned; a proper boat could get along all right when the river is up. Eighteen years ago the steamer Chehalis made a trip or two to a point 25 miles above Chehalis Station. * * * I think it doubtful if a raft could be constructed that would float down at the present stage of water; in some places there was not enough for the skiff with one man in it

A light scow would be the thing to carry the camp outfit and tools; men could jump over the side and wade and drift and drag such a craft over the shoal places. Mr. Abell told me that he had such a craft, left there by Mr. Hedges, but that it went out with the flood last winter. He has a little scow suitable for working from, which he says is in good order. The skiff I bought at Chehalis is hardly fit to work from as it is so narrow and cranky, easily upset. But if you conclude to do any work no doubt some plan could be devised. Centralia, I think, would be the nearest point to either place on the river, that I named the work might be done. From that station to the reservation the distance is about 15 miles by wagon-road and to Elma it is 25 or 30 miles.

There is no talk of any railroad reaching Gray's Harbor except the logging road being built by the Port Blakely Mill Company, and they will probably not extend it any faster than they require the logs.

The Satsop River comes into the Chehalis 2 miles below Elma; the Wynoochie and the Wishkah come in between that and its mouth. The two latter are navigable for 12 or 15 miles when the tide is in, and are good logging streams.

Respectfully submitted.

E. H. JEFFERSON.

Capt. CHARLES F. POWELL,
Corps of Engineers.

COMMERCIAL STATISTICS.

The Chehalis River is in the collection district of Puget Sound. Port Townsend, Wash., is the nearest port of entry. The nearest light-house is on Toke Point, at the entrance to Shoalwater Bay, Washington Territory, about 16 miles from the entrance to Gray's Harbor, into which the Chehalis empties.

The amount of revenue collected at Port Townsend during the year ending June 30, 1885, was $48,062.05.

Immigration and capital have been largely directed to the country tributary to the Chehalis River and Gray's Harbor. Lumbering near the mouth of the river and on the harbor, and farming on the river are the principal industries. Coasters ascend to Montesano, about 12 miles from the mouth.

STATEMENT BY MR. W. T. ABELL.

ELMA, WASH., *June* 23, 1885.

SIR: I have a steamboat called the Bay Center, 32 tons register, which I run from the mouth of the Chehalis River to the Elma Landing (head of tide-water), a distance of about 28 or 30 miles.

The river above Montesano is so obstructed with snags that I cannot make regular trips as far as Elma; if the obstructions were taken out there is water the year around for a light-draught boat as far as Elma. There is water seven or eight months of the year for a boat to Centralia on the Northern Pacific Railroad.

I have made several trips 20 miles above Elma during high water in the winter season, but it is difficult and dangerous on account of snags and jams in the river.

I cannot give a correct estimate of the amount of business on the river. I have freighted several hundred tons of freight, but I freight but a small part of it. The best part of the agricultural land is on the upper river, where a boat cannot get to it on account of obstructions. The valley of the Chehalis is an extensive body, good agricultural land, and is fast settling up, and the river is needed for transportation purposes. The great part of the transportation is done with wagons at great expense.

Three steamboats run on Gray's Harbor and the river all the time as far as Montesano. The river is bridged at Centralia and Chehalis.

Yours, respectfully,

W. T. ABELL.

Capt. CHARLES F. POWELL,
Corps of Engineers.

STATEMENT OF MR. M. T. CURRY.

CENTRALIA, WASH., *July* 9, 1885.

SIR: * * * The Chehalis River could easily be rendered navigable for boats drawing from 3 to 5 feet of water from here to tide-water at Montesano. But on account of jams, snags, and shoal bars, it has been impassable for several years. Hence it is impossible to give an account of the exports and imports of this region.

The navigation of the Upper Chehalis would be of inestimable benefit to this country, affording commercial facilities to the present settlers and inducing others to settle.

A large and fertile country is tributary to the Chehalis River between here and tide-water; but on account of impassible roads it is cut off from all the centers of trade for many months of the year.

Nothing could contribute to the development of this country so well as the removal of the obstructions of the Chehalis River between Centralia, in Lewis County, and Montesano, in Chehalis County.

I remain, sir, yours, very respectfully,

M. T. CURRY.

Capt. CHARLES F. POWELL,
Corps of Engineers.

S S 8.

GAUGING WATERS OF THE COLUMBIA RIVER AND PRINCIPAL TRIBUTARIES.

The object here is to operate an automatic gauge at Astoria and maintain staff-gauges above, for pilots' information, and for record of tides and stages of river, one service of the Astoria gauge being to show the condition of the bar at the mouth of the Columbia River with regard to roughness. It is also intended to measure the tidal and river volumes.

The Astoria gauge was operated from September 22 to the end of the year. Bar tug-masters and steamships' pilots have generally reported observations of the bar conditions at times of their crossings upon furnished forms, as requested, the special object being to accumulate data as to the control of the secondary movement of the gauge-pencil by the bar condition, and to determine a scale for closely reading such curve indications, as explained in the previous report.

Four standard staff gauges, reading to 10 feet above low water, were placed in September at Saint Helen's, Columbia City, near Martin's Islnd and near Walker's Island, Columbia River, for pilots' use; the taffs are black, graduated to half feet, the figures 6 inches high, and he division marks are zinc.

The Astoria sheets were partly read and tabulated. It is expected o complete this and to study the observations in connection with a eries obtained at Yaquina Bay.

The amount estimated as of profitable expenditure is for the year's pplication of the project.

APPROPRIATIONS.

Act August 2, 1882, gauging waters of the Columbia River from Astoria to the bar	$500 00
Act July 5, 1884, gauging waters of the Columbia River and principal tributaries	1,000 00
	1,500 00

Money statement.

July 1, 1884, amount available	$0 19
Amount appropriated by act approved July 5, 1884	1,000 00
	1,000 19
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	789 95
July 1, 1885, amount available	210 24
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	5,000 00

S S 9.

PRELIMINARY EXAMINATION OF THE ENTRANCE TO NEHALEM BAY AND RIVER, OREGON.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., October 22, 1884.

SIR: I have the honor to submit the following report of a preliminary examination of the entrance to Nehalem Bay and River.

The entrance to Nehalem Bay, as the mouth of the river is sometimes called, is on the Oregon coast, 39 miles south of the mouth of the Columbia River and 6 miles north of the entrance to Tillamook Bay.

The Nehalem Bay has an area of about 1¾ square miles. It is connected with the ocean by a narrow channel 2¾ miles in length, with a width varying from nearly one-half mile at its upper end to less than one-quarter of a mile near its sea end. The course of the channel, which is really the mouth of the river, is south. The bay lies east and west, while the channel runs south, close and parallel to the ocean, from which it is separated by a narrow peninsula of barren sand. Passing from this arm into the sea, the river parts into three small outlets. The main one continues in the general southerly course for three fourths of a mile, at first nearly parallel to the beach, and then turning gradually to the ocean.

Assistant Engineer Eastwick, who made the examination, was not able to procure any facilities for getting on the bar when he was at the bay, and was obliged to content himself with a view of the bar from shore. This was done at low water from the sand-spit of the peninsula. It was also learned, on good information, that the bar is of shifting sand without rocks. Apparently there is no rock formation on the immediate coast between points about 6 miles above and below the entrance.

As far as known no vessel has ever crossed the bar.

A survey of the entrance to the river was made by the Coast Survey in 1868. The map of this, not published, on a scale of $\frac{1}{5000}$ shows the curve of 2 fathoms depth at low water from the inside; exterior as depths of 7, 8, and 11 feet, and beyond breakers are noted from shore to shore.

On the inside the channel, as shown on the map, of 2 fathoms or more in depth, leading to the river, is from 100 to 200 yards in width. About midway between the ends of the channel the 2-fathoms curves are separated for a length of one-fourth of a mile, on which are only 10 and 11 feet depths. At other places in the channel are 4 and 5 fathom soundings. At its head, where the channel joins the bay, or properly speaking a wide reach of the river, a 9 feet curve only can be traced to the limit of the survey, about three-fourths of a mile beyond the head.

Mr. Eastwick reports that his soundings in the bay gave a minimum depth of 10 feet at low water, with no considerable extent of deeper water. He further notes that at extreme low water an extensive sand bar is exposed in the middle of the bay, and that tidal currents of 6 to 7 miles per hour flow through the narrow channel connecting the bay and ocean. His soundings in the channel agree with those on the Coast Survey map. The bottom is sand and mud, except on the shore opposite the lower end of the peninsula, where a small ledge of rock is shown.

A second Coast Survey map, 1875, scale of $\frac{1}{10000}$ I believe, also not yet published, shows 6 feet curves of depth extending from shore to shore at the sea bar, and breakers are marked over its whole extent. The least distance between the outer and inner 1-fathom curves is about 225 feet. The soundings are not given on the map; probably there is less than 6 feet in the bar channel. The map includes the wide reach of river near its mouth, one called the bay. It shows a channel near the south shore and a cut-off around a sand-bank, both of equal or less width, to the narrow arm connecting this reach with the sea. An extensive mud flat, bare at low water, is marked on the north side of the reach.

An engineer survey of the mouth of the Nehalem River was contemplated in the act of March 3, 1875. A report recommending, for reasons stated, the postponement of the survey, is given in a letter of the Secretary of War, Senate Ex. Doc. No. 42, Forty-fourth Congress, first session. It appears from this report that the people of the Nehalem vicinity desired an official chart of the sea entrance, "showing course or courses of the channel, its breadth, and the depth of the water therein at high and low water, also the depth and character of the water on each side of the channel, and that such chart shall embrace the waters contiguous to the entrance outside and inside, as far as is customary for the Government to make such surveys and maps;" and that the chart was wanted so that mariners and others who may wish to visit the river can have the necessary information; in other words, a chart for sailing purposes, instead of an examination with a view to a navigation improvement.

It further appears that the postponement of the examination was made in expectation that the required information would be duly supplied in the course of the progress of the Coast Survey.

Enough is known of the Nehalem bar to conclude that it is too shoal for easy crossings by the smaller class of coasters. Works of contraction would probably give a channel of required depth and stability for these vessels. But it does not appear to me that the least cost of improvement works is warranted by the traffic of the region in its present state of development. I have to report, therefore, that the entrance to Nehalem Bay and River is not now worthy of improvement.

An extract of a report of an examination of the lower Nehalem region by Assistant Engineer Eastwick is appended, and also a description of a late trip down the Nehalem River by Mr. J. L. Barnard, esq., of Portland, Oregon, who is interested in a project to establish a saw-mill on Nehalem Bay, and who made the trip to examine the timber of the country.

Very respectfully, your obedient servant,

CHAS. F. POWELL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. PHILIP G. EASTWICK, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., *October* 11, 1884.

SIR: I have the honor to submit the following report of the examination of the lower part of the Nehalem River and the entrance thereto, made in compliance with your instructions:

* * * * * * *

The entire valley of the Nehalem and of its tributaries is inclosed by mountain slopes, at the basis of which generally are to be found areas of varying width of bench or bottom land, some of which is occupied by settlers.

Where the river passes through the coast-range the valley is narrowed by the hills coming close to the river, thus separating the upper and lower settled districts. This confined reach of the river is estimated to be about 20 miles in length. Through it there are no facilities for travel except that afforded by a rude trail over which horses can be taken with difficulty. The upper district is accessible from Saint Helen's, Westport, and Astoria, on the Columbia River, and from Forest Grove, on the Oregon and California Railroad, by roads and trails over the intervening mountains. The lower district is only accessible at present from the north by means of two trails from Seaside, on the south end of Clatsop Beach, and from Tillamook Bay, on the south, by the ocean beach. Wherever the trails leave the beach they enter the mountains, where they are steep and very undulating, passing over high elevations, and during the rainy season are almost impassible by horsemen.

My personal examination extended only to that part of the lower district in the immediate vicinity of Nehalem Bay and the entrance to it from the ocean.

In the lower district there are at present forty-one families and an aggregate population of about 150. The industries followed are farming on a limited scale, cattle raising, and butter-making. The expense of getting products to market is such as to limit the production of the country. During the season just closed there have been sent out from the district 10,000 to 12,000 pounds of butter in kegs and 300 head of cattle. The butter has been taken to Tillamook Bay by teams on the sand-beach, and thence by boat to the steamboat landing at Hobsonville. The cattle were driven out over the trail to Seaside, and thence to Astoria. This district is capable of supporting a largely increased population whenever more convenient channels to market are opened.

The tidal compartment of the river traverses a flat valley of bottom land and tide-marsh varying in width from one-fourth mile to one and one-half miles. But a small part of the available agricultural land is at present cleared and under cultivation. The flanking hills are generally quite precipitous, and, with the exception of an occasional bald area, are generally heavily timbered.

To the north of Nehalem Bay, as far as the foot of Necarney Mountain, which is about 3 miles distant, the country is hilly and the soil sandy; a large extent of this is prairie land, and used principally for grazing. Necarney Mountain is a very high ridge with very precipitous slopes extending inland from the ocean.

The western and southern slopes are barren of trees. Around the flank of the mountain the trail to Seaside passes, reaching a maximum elevation of about 850 feet above the sea. This ridge terminates on the ocean in a high vertical bluff. On the south side of the bay the slopes of the hills terminate close to the water. The hills are steep and high and heavily covered with timber. This continues down the left bank of the channel, connecting the bay with the ocean. To the west of Nehalem Bay lies a heavily rolling, barren, sandy plateau. To the south of this plateau extends the low, sandy peninsula over 2 miles long, separating the lower arm of the bay from the Pacific Ocean. This peninsula is bare of soil or vegetation.

* * * * * * *

On the uplands adjoining the upper part of the river are found large areas of land heavily timbered with fir and some hemlock, and on the lower lands and bottoms spruce, alder, and cedar of excellent quality is found.

The first run of salmon enters the river in July and continues until the close of September. This fish is an excellent one for canning or salting, and averages 30 pounds in weight. The second run commences at the close of the first run and continues from six weeks to two months. They are known as the "silversides," are very plentiful, and weigh from 12 to 15 pounds. They are valuable chiefly for salting. The third run, known as the "chum salmon," is an inferior fish, not suitable for canning, but can be used for salting and for the oil they yield. They commence to run in November and continue all winter.

Lignite coal of good quality has been discovered in the mountains adjacent to the Lower Nehalem district; but little is yet known of the value or extent of the coal fields.

It is also reported that limestone in considerable quantity is found in this district.

For some years past a number of parties have had their attention called to this river with a view to the establishment of saw-mills and fisheries, but have been deterred from investing in these enterprises for want of reliable information as to the bar at the entrance.

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Very respectfully, your obedient servant,

PHILIP G. EASTWICK,
Assistant Engineer.

Capt. CHAS. F. POWELL,
Corps of Engineers, U. S. A.

REPORT OF MR. J. L. BARNARD.

PORTLAND, OREG., *October* 10, 1884.

Eight or nine miles up the coast from Garabaldi, in Tillamook County, there empties into the Pacific Ocean a beautiful river called the Nehalem, draining the country for more than 100 miles in length, running through three counties, and very circuitous in its course, as one can imagine when they learn that the source is only about 15 miles distant from its mouth. On this river are three settlements.

Leaving Portland, and proceeding down the river Columbia as far as Saint Helens, we found a wagon-road 25 miles in length, which brought us to Browse's Mill, about 100 miles from the mouth of the Nehalem River. This is called the *upper settlement*, and has a population of one or two hundred people who have taken up farms along the river. Here we built a boat, 24 feet long and 3 feet wide, and procuring some pitch from a tree near at hand, boiled it down and made the bottom water-tight.

Securing the services of two men, both of them being raftsmen, with the surveyor of Nehalem, we proceeded to make the first trip ever made by white men from the upper Nehalem to the ocean, and on our way passed beautiful timber of fir, spruce, hemlock, and cedar, and occasionally clearings where the settlers were making homes for themselves.

On the second day we came to the *middle settlement*, where the three Fish Hawk Rivers empty into the Nehalem. Here we found some good farming lands. On the morning of the third day, as we were paddling down the river, we landed on the right bank in search of game, and scarcely had the first man landed before we heard the crack of a rifle, repeated time and again, and looking down the river we could see a band of elk, about thirty in number, trotting through the brush along the river bank. From this point we soon passed the military trail cut from Forest Grove to Astoria, which was formerly used, but now abandoned. Here the cedar timber belt commences, the best of which is found high up on the mountain sides. The banks of the river are abrupt and rocky, the mountains in many places coming down to the river banks, down which the timber can be easily rolled into the river.

From the middle settlement to the commencement of the lower settlement, which is about 15 or 20 miles from the mouth of the river, the country is an *unsurveyed wil-*

derness of timber, not a person to be seen except an occasional hunter or trapper. Here we met two Indians making a fish-trap to catch salmon, who, speaking to me in Chinook, asked where we came from. When I answered from the upper Nehalem, they said, "You never came down in that boat." They wouldn't believe it, as only canoes had ever come over the falls. On the fourth day, in the afternoon, tired and hungry, we found a comfortable house close to the river, occupied by Alfred Deane and his good wife, who entertained us hospitably. Half a mile from this place a bend in the river brought us into the Nehalem River, at the junction of the North and South Forks, a beautiful stream, 600 feet wide and quite deep.

We were now in the lower settlement, among the hill farms and tide lands, for this is practically a stock-raising and dairying section of country, with immense tracts of timber, at this point chiefly spruce, hemlock, and fir, with some cedar. Game is very abundant—elk, bear, panthers, &c. The river is full of immense salmon in August and September, averaging 35 pounds, and one caught while I was there weighed 85 pounds.

There are no roads in this section of the country; every one is dependent upon boats or canoes. There is, however, one very steep, narrow, miserable trail over to Clatsop, traveled principally by the mail-carrier and occasionally by footmen. The houses are built of logs covered with shakes. The occupation of the people is hunting, fishing, trapping, and dairying; about one hundred inhabitants, and more settlers constantly arriving. School districts, two; no church edifice, but occasional preaching—very rarely. As soon as communication with the outside world is opened great changes will take place in these respects, and a better class of settlers avail themselves of the rich soil unoccupied and a very beautiful climate close by the sea.

Four miles from this settlement the river widens into a bay, and there we find a beautiful mill-site, with timber to the water's edge, and water 30 feet deep 18 feet from the shore.

The object had in view in taking this trip was to personally ascertain some knowledge of the resources of this country drained by the Nehalem River, and we paid particular attention to the bed of the river and its banks, for logging purposes. I found only one piece of slab-wood lodged in the bed of the river from Browse's Mill to tide-water, with one lodgment of drift-wood on top of a rock about 20 feet high in the middle of the river, left there during some freshet, showing that it is a beautiful stream to run logs down, for 100 miles or more, to tide-water, furnishing an almost inexhaustible supply of timber. There are deposits of coal 3 miles from tide-water.

With an expenditure of a little energy and money this would be a splendid dairy section, being on the coast. From the tide lands immense quantities of hay and grain could be produced, but before they can be utilized the bar at the mouth of the river should be surveyed and buoyed, as there is plenty of water to admit vessels drawing 16 feet. The channel is narrow but deep; the bar, nine months in the year, comparatively smooth, not being as rough as the Tillamook Bar.

J. L. BARNARD.

S S 10.

PRELIMINARY EXAMINATION OF OLYMPIA HARBOR, WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., *October* 28, 1884.

SIR: I have the honor to forward the appended report of Assistant Engineer P. G. Eastwick, on a preliminary examination of Olympia Harbor, Washington Territory. I am informed about this harbor, and I concur in Mr. Eastwick's report that it is worthy of improvement. The following estimate of cost for a survey is submitted:

FIELD WORK.

One assistant engineer, $\frac{25}{30}$ month, at $175	$145 83
Two aids, $\frac{25}{30}$ month, at $90 each	150 00
One recorder, $\frac{25}{30}$ month, at $60	50 00
Four laborers, $\frac{20}{30}$ month, at $50 each	133 33
Two rodmen, $\frac{20}{30}$ month, at $50 each	66 67
One leadsman, $\frac{20}{30}$ month, at $60	40 00

Traveling expenses, 3 men to and from Olympia, at $16 each	$48 00
Tools and material	75 00
Hire of boat	25 00
OFFICE WORK.	
One assistant engineer, 1 month	175 00
Materials	25 00
	933 8[illegible]
Add 10 per cent. for contingencies	93 [illegible]
Total	1,027 [illegible]

Very respectfully, your obedient servant,

CHAS. F. POWELL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF PHILIP G. EASTWICK.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., October 27, 1884.

* * * * * * *

The town of Olympia is situated near the head of Budd's Inlet. Between the lower wharves of the town and the low-water line of the inlet there is a distance of over three-quarters of a mile which at low water is a bare mud-flat. Through this are a number of crooked channels, the deepest of which shoals to less than 3 feet at low water. Owing to the windings of the channels and their shoalness, none but the smallest steamers can ascend to the town at low tide. Those drawing 2½ feet and upwards are very frequently compelled to remain below the town until the tide rises—much to the discomfort of passengers and the detriment of the trade.

The town of Tumwater, at the head of the inlet and about 2 miles above Olympia, is accessible by steamers of light draught only when the water is above half-tide, and as there is no regular lines of steamers running there, and no occasion for them, there is no need of an extension of any harbor improvements from Olympia to that point at present. The limited business which is now done by water with the town of Tumwater finds adequate facilities with the present condition of channel.

An inspection of the Coast Survey chart of 1876 shows an extent of mud-flat of three-quarters of a mile to the low-tide line, and a further distance of three-eighths of a mile to the 6-foot curve of depth at low water.

It appears quite desirable that a channel of 6 feet depth at low water should be provided, so that ordinary light-draught vessels navigating the sound may at all times reach the wharves at Olympia, and that the existing deeper parts of the channel which are now to be found at the wharves on the west side of the town be enlarged and, if necessary, deepened so as to form a basin to accommodate deeper draught vessels which may be brought over the mud-flats at high tide.

A project for an improvement of the harbor and an estimate of its cost can only be made after a careful survey of the harbor. The need for an improvement is apparent.

The total business done with Olympia by the regular lines of steamers terminating for the year ending September 30, 1884, is estimated as follows:

Number of passengers	32,000
Tons of merchandise	8,500

Other steamers making occasional trips to the town add to these amounts quantities which cannot be reliably estimated. Among the exports of merchandise by steamers are hides, wool, furniture, sash, doors, and hops.

The population of Olympia is estimated at about 2,500. It is the capital of the Territory and the county seat of Thurston County. Its principal support is derived from the trade which it receives from the interior farming country and from points on Puget Sound.

The Olympia and Chehalis Valley Railroad, a narrow-gauge railroad, 14 miles long, traversing a good farming country, connects the town with the Northern Pacific Railroad at Tenino. Three other railroads, used exclusively for the transportation of saw-logs terminate on the inlet above Olympia. About 17,000,000 feet of logs were brought down during the last twelve months over these roads. These logs are made up into booms at Olympia and towed down the sound.

The town of Tumwater has a population of about 300. It is situated on the Des Chutes River where it empties into Budd's Inlet. The falls of the Des Chutes are located here. They have a fall of 82 feet, and at low water in the river the volume of water passing over the falls is estimated at 8,000 cubic feet per minute. This water-power is used to drive the machinery of three grist-mills, two saw-mills, two sash and door factories, and one tannery. The present capacity of the grist-mills is about 200 barrels flour and 40 tons mill-feed daily, and that of the saw-mills 35,000 feet, B. M., daily. These manufactures are used at Olympia and in the interior, but little being at present shipped by water.

Connecting the town of Olympia and the west shore of Budd's Inlet is a pile bridge three-eighths of a mile long. A pivot-span has been placed at the east channel, having a clear opening of 36 feet on one side of the pivot-pier. The decay of the timbers of the pier has caused the bridge to settle, and it is with difficulty that it can be opened or closed. The pier is in such an unsafe condition that it is liable at any time to fall over against a passing vessel when the bridge is open. In its present condition the bridge is a serious impediment to the navigation. The principal need of the bridge opening is to pass tow-boats with their booms of logs. The bridge was built many years ago by funds raised by the inhabitants of Olympia, and subsequently turned over to the care of the town authorities, who are supposed to keep it in repair and attend the draw, but which they neglect to do properly.

A county bridge across the head of Budd's Inlet at the town of Tumwater, about 1,800 feet long, is built upon piles. It has a draw-opening of 40 feet in width. This bridge is now considered unsafe for the passage of teams, and its use has been abandoned except for foot passengers. The county authorities have no one stationed at the draw to open and close it, this work being left to those who desire to pass through. The result is that it seriously interferes with the free movement of log-booms, and in its present condition can be called a serious impediment to the navigation of the upper part of Budd's Inlet.

Very respectfully, your obedient servant,

PHILIP G. EASTWICK,
Assistant Engineer.

To Capt. CHAS. F. POWELL,
Corps of Engineers, U. S. A.

SURVEY OF OLYMPIA HARBOR, WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., January 31, 1885.

SIR: I have the honor to submit the following report of a survey of Olympia Harbor, Washington Territory, as provided for in the act of Congress approved July 5, 1884, and an estimate of the cost of works of improvement.

The survey, tracing* of which is forwarded herewith, was made by Mr. von Geldern, assistant engineer.

Olympia, the capital of Washington Territory, is situated at the head of Budd's Inlet, upon both sides of it, but principally upon the eastern. The inlet at Olympia is about three-eighths of a mile wide, and at low tide consists only of a mud-flat, through which are a number of narrow and tortuous channels with a depth of water of less than 2 feet. Low-water mark is at a distance of about 4,000 feet from the lower wharves of the town, and, owing to the shallow and tortuous nature of the channels referred to above, boats of even the lightest draught are compelled to remain below the town until the tide rises.

The plane of reference being extreme low water, higher low water is from 9 feet to 11 feet, and higher high water from 18 feet to 20 feet above that plane.

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* Tracing omitted.

The flat is composed of a blue silt overlaid to the depth of a foot or more with a hard crust containing gravel, marine shells, &c.

Piles are attacked by the *Teredo navalis* to a certain extent, but not so largely as at other Puget Sound points.

Budd's Inlet extends about 2 miles beyond Olympia to Tumwater, at the mouth of the Des Chutes River. It is navigable to this point for only the lightest-draught steamers and only at high tide. No improvement should be extended to that point at present; but the existence of a fall of 82 feet in the Des Chutes River at Tumwater, furnishing a large water power for present and future manufactures, and also the position of the Olympia and Chehalis Valley Railroad on the west side of the Inlet, furnishing a means of transportation of these manufactures to the steamboat wharves, are points to be considered in the location of any proposed improvement.

Connecting the town of Olympia with the west side of the Inlet and with the depot of Olympia and Chehalis Valley Railroad is a pile bridge built in 1868, with a draw opening of 40 feet upon the Olympia side. This bridge has acted as an obstruction to the free outflow of the ebb tide, and the presence of the draw opening on the eastern end has drawn the tidal currents in that direction, deflecting them somewhat from their natural course down the western shore of the inlet, and causing a slight scour under the draw span and in front of the steamboat wharf. There is no navigation above this bridge, and the draw is said not to have been opened for several years. Some rafting and booming of logs and lumber has been done between Olympia and the mills at Tumwater.

PROPOSED WORKS OF IMPROVEMENT.

To dredge a cut to a depth of 8 feet below extreme low water, of a width at the bottom of 100 feet, and with side slopes of one vertical on two horizontal. This cut is proposed upon the line *a b*, near the western side of the inlet, and from the 8-foot curve to a point on the pile bridge near the railroad depot, following the line of the natural flow of the ebb tide.

At the head of this cut, to dredge a basin 400 feet long, with a width of 400 feet, to a depth at extreme low water of 8 feet.

To build from Capitol Point, and on the line *c d* nearly due north, being in the direction of the proposed cut, a dam of stone and brush to a height midway between the crest of mud flat and higher high-water line—that is, to a height of 14 feet, more or less, above low water. The estimated cost of these improvements is as follows:

310,000 cubic yards dredging, at 40 cents per cubic yard	$124,000
1,500 feet of stone and brush dam at $7 per linear foot	10,500
Engineering and contingencies, 10 per cent	13,450
Total	147,950

The estimates for excavation are upon the assumption that all the material in the cut would have to be dredged. It is thought that with a free opening in the pile bridge at the head of the cut the current, properly directed by the dam, would assist materially after the top hard crust had been removed. The reasons for the selection of the western side of the inlet as the position of the proposed cut are as follows:

A direct route from the bridge to deep water, following the line of the deeper pockets and of the natural flow of water from the Des Chutes River and from ebb tides.

Better means of keeping open a dredged channel on this line than any other by directing the flow of these currents by a short wing-dam as proposed.

A direct communication with Tumwater and the Chehalis Valley, the sources of present and future manufactures and agricultural products for export. Olympia freights, being chiefly of supplies for local use, would be but slightly inconvenienced by the increased haul of less than half a mile.

The proposed cut is on the line that should be occupied by a channel for deep-sea vessels, should such an improvement be decided upon in the future. The citizens of Olympia desire such a channel; but the expense of such an improvement would not at present be justified.

Should the above-plan of improvement be adopted, certain changes would have to be made in the pile bridge so often referred to, looking to as free an opening of 400 feet as is possible at the head of the cut. This bridge is owned by the town of Olympia and in a very bad state of repair. Owing to the interest taken in the improvement by the citizens of Olympia, the town may undertake to make these alterations.

Very respectfully, your obedient servant,

EDW. BURR,
First Lieut. of Engineers.

To the CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. G. H. Mendell, Corps of Engineers, Supervising Engineer.)

[First indorsement.]

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., March 10, 1885.

Respectfully forwarded approved.

G. H. MENDELL,
Lieut. Col., Corps of Engineers.

S S II.

PRELIMINARY EXAMINATION OF PUYALLUP RIVER, WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oregon, November 3, 1884.

SIR: I have the honor to submit the following report of a preliminary examination of the Puyallup River, Washington Territory.

This river, some 80 miles long, with several small tributaries, empties into Puget Sound, at the head of Commencement Bay and near the city of Tacoma. The upper section of the river is a mountain stream. The lower section, 14½ miles long, is in part a tidal slough.

Beyond the reach of the tide for 12¼ miles, to Moore's farm, which marks the division between the upper and lower sections, the river is from 100 to 200 feet wide, and not less than 36 inches deep at low water. The obstructions in this part consist of snags and drift.

The river has a delta mouth, at which the mean rise of tide is about 15 feet. On the tidal portion there are shoals with only a few inches depth at low water.

An instrumental examination of the river was made in 1875, for compliance with the act of March 3 of that year. Reports thereof with maps were submitted by Majors Michler and Wilson, Corps of Engineers, and are published on pages 641 and 669 of the Report of the Chief of Engineers, 1876.

This examination was required to be made from the mines of the Puyallup coal-fields to the mouth of the river. The mines are some 17 miles above Moore's farm.

Both reports of the examination of 1875 stated to the effect that the upper section could not be made navigable without undue expense. Major Wilson submitted a project for improving the lower section. His plan consisted of snagging work on the part above tide, and of bar scraping and contraction of water-way by cut-off dams on the tidal reach. The estimated cost of plant and its operation for six months and of 700 feet of dams, was $11,836. His dams were to close the east channel of the river mouth.

During the present month Assistant Engineer P. G. Eastwick visited Tacoma and Puyallup and conferred with many of the citizens interested in the wants of the Puyallup Valley, and personally examined into the need of improving the river. I had also previously examined the lower part of the river, especially with reference to some contemplated private harbor facilities at the mouth.

Since 1875 the Northern Pacific Railroad Company has constructed a railroad connecting the Puyallup coal-fields with tide-water at Tacoma. This road descends from the coal-fields, by the valley of the South Prairie Creek, to a point about 7 miles above Moore's, and thence follows down the Puyallup Valley. A branch to this road was lately built from the mouth of Stuck River, near Moore's farm to Seattle, and crossing the Puyallup—these two roads thus forming an extension of the main line of the Northern Pacific from Tacoma to Seattle.

The railroad bridge and a county wagon-road bridge, spanning the river about 2½ miles below Moore's, are both low and without draws. The county bridge is located just above the town of Puyallup. Both structures would be obstacles to navigation. The measure of the need for the improvement of the lower section of the river is different now from what it was at the time of the examination in 1875.

Formerly the channels of communication were only those afforded by the county roads, which, at all times insufficient, were, during the rainy season, unavailable. The opening of the lower section of the river by the removal of drift and snags appeared to be essential to the prosperity of the valley. The completion of the railroad through the valley has furnished the facilities which, at that time, were considered all that were necessary.

The valley has, however, shared in the general progress of the country, the population has largely increased, and the area of land under cultivation been greatly extended.

Except coal-mining, whose product could not be shipped by the river, the principal industry of the valley is hop-growing. An estimate of the area under cultivation this season places it at 1,154 acres, yielding about one ton per acre. Hay, potatoes, and other farm products are raised in considerable quantities.

Railroads would probably continue to transport the greater part of the hops, even if the river were navigated, as the product is generally shipped East by rail, and no saving in freightage would occur by delivery on the cars at Tacoma, over adjacent towns, as Puyallup.

A part of the product, however, which is sent to San Francisco would have more of a competitive transportation than now exists if river navigation were available, and also independent wharfage at Tacoma.

But the special need of river navigation is a cheaper transportation of ordinary farm products to the places of local demand and of return store supplies. These places are Tacoma and various mill towns and logging camps on Puget Sound and its tributaries. The farm products will not bear the cost of reshipment at Tacoma in addition to the rail charge of $2.50 per ton from Puyallup, as stated by valley shippers. With increased facilities for getting these articles to market their production would be greatly increased.

The river, which in 1875 was completely blocked by three drift jams between Moore's and the reach of tide, has been partly opened by private work, to permit the passage of canoes. The hop culture has caused a large annual temporary influx of Indian hop-pickers to the valley, who now go up and down the river in large-sized canoes.

The amount of this private snagging work bears but a small ratio to that required for navigation of steamers.

I have to report that the Puyallup River is worthy of improvement to the extent of snagging operations, as far up stream as the county bridge, and that a survey is not necessary.

The cost of the work would probably be the same as for each of the Puget Sound rivers, Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie, viz, $3,000 annually.

The Government has entered upon an improvement of these streams consisting of snagging and moderate bar scraping. The Puyallup River work could readily be included under an increased appropriation for the other rivers.

Since a large rise of tide occurs twice daily at and near the delta, it does not appear necessary for the present to attempt a deepening of the channel for low-tide navigation. I judge that such improvement would require considerable dredging in addition to channel contraction.

The harbor facilities contemplated by a local improvement corporation subordinate to the Northern Pacific Railroad consist, among other things, in closing the west mouth at its head and in dredging the flat in advance of this channel for a capacious ship basin.

The closing of either mouth would be conducive to deeper water in the other. The examination of 1875 showed that the east mouth carried two-thirds of the river's volume. The project based on that examination provided, however, for retaining the west channel, and for the reasons, I judge, that it was more convenient to the Tacoma water front. This front, both banks of the west channel, and the peninsula between the two channels, now belong to the improvement company. Under these circumstances which monopolizes the adjacent wharfage and makes necessary wagon and rail crossings around the head of the intended ship basin, it appears that the reasons for keeping open the west channel do not any longer obtain.

With present information I should select the east channel for the navigable mouth, and therefore conclude that the wharfage obstructions would not interfere with the present recommended nor future river improvement.

Very respectfully, your obedient servant,

CHAS. F. POWELL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

S S 12.

PRELIMINARY EXAMINATION OF WILLAPAH RIVER, WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, *Oreg.*, *October* 21, 1884.

SIR: I have the honor to submit the following report of a preliminary examination of the Willapah River, Washington Territory.

This river is the main stream of a number of small tributaries of Shoalwater Bay, a long, narrow arm of the sea, whose entrance is 2 miles north of the mouth of the Columbia River.

The Willapah is naturally divided into two parts, the tidal compartment and the upper river. The division, some 17 miles above the mouth, is marked by a ledge of soft rock occupying the bed of the river for about 150 feet, and causing a fall at low water of about 2 feet. Extreme high tides back over the falls for 1 mile or 2 miles.

South Bend, the principal place of the region, is a lumber town, 2 or 3 miles above the mouth, whose monthly shipment averages 1,000,000 feet, and which is sent to San Francisco in vessels drawing as much as 15 feet.

Woodard's Landing, the second place of importance in the region, is some 10 miles above South Bend. On this section of the tidal portion the ebb and flow are not materially obstructed. The main rise of tide is about 8 feet. The river is wide and passes in a winding course through a wide valley of low bottom and tide land. The depths are generally good; three bars have channels of 7 feet at low water; the uppermost bar is of soft clay rock, and about 300 feet across; the other bars are of sand, and 800 to 900 feet long.

The South Bend vessels could readily go to Woodard's at high tide if required; the few snags found in the reach offer no material obstruction.

At Woodard's Landing are two stores, two hotels, and a warehouse. Existing business is that sustained principally by the logging industry of the upper river.

A crib pier has been built in the middle of the river, opposite the landing, for securing saw-logs, which are here made into rafts and towed the mill

The South Fork enters the main stream a few miles above South Bend: it traverses the tide land for 2 or 3 miles. This part is navigable by the bay steamers. Above the fork is a shoal stream emerging from a hilly country.

Above Woodard's Landing the stream is crooked, and the bends are abrupt. Wilson's Landing, where there is a small warehouse, is ¾ miles from Woodard's. Mallis's Landing, where there is another warehouse, is nearly 2 miles further.

Between Woodard's and Wilson's the river is 150 to 200 feet wide. The banks are still low, and much of the adjacent land is bottom. About fifty snags were counted in this short reach. Their removal would give navigation at all stages for vessels drawing 6 feet.

Between Wilson's and Mallis's the river is generally from 100 to 150 feet wide, but it narrows in some places to 75 feet. The bottom is of sand and fine gravel. The channel at its shoalest bars is 20 inches deep. Two hundred snags and pieces of lodged drift nearly block the channel. Steamers have been nearly half way up this reach when stopped by snags. Were these removed the stream would here be navigable at half tide for light-draught river craft, and at ordinary high tide for the steamers plying on the bay and lower river.

These at present are the following:

	Feet draught.
Montesano (stern-wheel)	2½
South Bend (screw-tug)	6
Favorite (screw)	5
Hunter (screw-tug)	9½
Garfield (screw)	5

Above Mallis's Landing the short reach of the river of three-fourths of a mile to the falls has at low water the character of a rapidly falling mountain stream. It is narrow and crooked and much clogged by drift and snags. Navigation here will be possible only by light-draught steamers at high water and after the removal of the drift and snags.

The bottom and tide lands are sparingly settled. Much of the tide-land is natural prairie. It produces large crops of hay and roots, but, owing to the overflow at the extreme high tides, grain is raised only in limited quantities and in the favorable situations.

The upper river is a stream with a moderate fall and numerous shoals and riffles. Its length is variously estimated at from 30 to 40 miles, though, owing to its many windings, the valley through which it passes does not much exceed half that length. It is not navigable at low stage by steamers or rafts, but it is of sufficient size and depth for driving saw-logs. But one material impediment to this is reported, viz, at Rocky Ford, about 15 to 20 miles above the head of tide; it is of trap rock, about a quarter of a mile long, and where the stream is too shoal, except on a rise, for floating logs.

The valley of the upper river is from one-half mile to 1½ miles wide, with gently-rising hills. It is thinly settled for a distance of about 20 miles above Wilson's Landing. The population is estimated at about 300. The valley is inclosed by high ridges, making access to and from it difficult by any route other than that of the valley of the river and in the direction of the sea. Two trails connect the upper part of the valley with the Upper Chehalis and with the Pacific Division of the Northern Pacific Railroad. These trails are rough and hilly and not much used. Adjoining hills are reported to be well covered with excellent fir timber. Cedar of good quality is found on the lower lands and on the bottoms. Many logging camps are scattered along the river and its tributaries, and from them about 12,000,000 feet of logs are annually driven to supply the saw-mill at South Bend.

Farm exports from the upper valley are at present very limited in amount, the products being consumed at home and in the logging camps.

The valley throughout is well adapted to grazing and dairying. It is not an agricultural region, although the small valleys and great extent of tide-land, with reclamation, are capable of high cultivation. Timber and range constitute the present principal value of land.

The lower district has as good an outlet by the river as can be furnished.

The removal of the bars below Woodard's Landing is not now necessary, nor will it be until the population and industries of the upper country are largely increased.

The inhabitants of the upper district at present make connection with the navigable portion of the river at Woodard's Landing. To do this they cross a high ridge on the right bank of the river next below Wilson's Landing, and those on the left bank must ford the river.

More convenient points to connect with the river are at Wilson's Landing, on the right bank, and at Mallis's on the left. Between these points and Woodard's Landing the river should be improved by the removal of snags and drift. This would afford an unobstructed channel for the steamers now navigating the waters of Shoalwater Bay at all times to Wilson's Landing and at high water to Mallis's Landing.

I have to report that the Willapah River, below the uppermost landing (Mallis's), is worthy of improvement to the extent of snagging work, and that a survey is not necessary.

About two hundred and sixty snags and pieces of lodge drift were counted during the examination. The contract price for the removal of such obstructions on the Cowlitz River, Washington, is $5 apiece. Estimating on this price, and allowing $200 for inspection and other expense of the contract, the cost of the improvement recommended is $1,500. This is intended to cover one good snag clearing of the lower river

Before the stream shall have become again seriously blocked bar-channel improvement will doubtless be required for the larger craft on the bay and for coasters. A survey will then be necessary.

A plan of improvement based thereon will probably include annual snagging operations. I am not assured of the need at the present time of such work.

Very respectfully, your obedient servant,

CHAS. F. POWELL,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX T T.

IMPROVEMENT OF THE WILLAMETTE RIVER ABOVE PORTLAND, OREGON—CONSTRUCTION OF CASCADES CANAL, COLUMBIA RIVER—IMPROVEMENT OF UPPER COLUMBIA, SNAKE, AND COWLITZ RIVERS, OREGON AND WASHINGTON TERRITORY, AND OF LOWER CLEARWATER RIVER, IDAHO.

REPORT OF MAJOR W. A. JONES, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Upper Willamette River, Oregon.
2. Columbia River at the Cascades, Oregon.
3. Upper Columbia and Snake rivers, Oregon and Washington Territory.
4. Cowlitz River, Washington Territory.
5. Lower Clearwater River, Idaho.

EXAMINATIONS AND SURVEYS.

6. Snake River between Lewiston and mouth of Boisé River, Idaho.
7. Cœur d'Alene Lake and River, Idaho; Saint Joseph's River, Idaho.
8. Lewis River, Washington Territory.
9. Columbia River above mouth of Snake River, Washington Territory.
10. Upper Columbia and Snake rivers.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., July 25, 1885.

SIR: I have the honor to transmit herewith my annual reports for the works for river improvement in my charge for the fiscal year ending June 30, 1885.

At the beginning of the fiscal year all these works were in charge of Capt. Charles F. Powell, Corps of Engineers.

COMMERCIAL STATISTICS.

The commerce of all the region in which these works lie centers in Portland Oreg.

These rivers are in the collection district of Willamette. Portland, Oreg., is the nearest port of entry. The nearest light-house and works of defense are at the mouth of the Columbia River. There are several military posts in the district.

AMOUNT OF REVENUE COLLECTED AT THE PORT OF PORTLAND, OREGON, DURI THE DECADE ENDING JUNE 30, 1885.

1876	$189,239
1877	125,317
1878	131,352
1879	139,149
1880	97,441
1881	392,891
1882	332,664
1883	327,756
1884	402,290
1885	189,481
Total	2,327,584

Total of imports and exports for ten years ending January 1, 1885.

Years.	Imports.	Exports.
1875–'76	$355,149 00	$2,306,264
1876–'77	388,476 00	2,508,159
1877–'78	460,287 00	3,922,226
1878–'79	399,440 00	3,157,575
1879–'80	264,638 70	4,081,188
1880–'81	566,021 00	2,797,088
1881–'82	639,316 00	5,334,588
1882–'83	678,851 00	3,760,077
1883–'84	805,945 00	5,274,085
1884–'85	477,778 00	3,795,854
Total	5,085,896 70	36,891,896

Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

T T 1.

IMPROVEMENT OF THE UPPER WILLAMETTE RIVER, OREGON.

The object of the improvement of this river is to secure light-draught navigation as high up as Eugene City, inclusive of 6 miles on Long Tom Creek, an aggregate distance of 184 miles. The plan consists of snagging, bar-scraping, wing-dam construction, and rock-blasting. The present project was adopted in 1878. Estimated cost $80,000, exclusive of about $12,000 per year for maintenance. Total amount appropriated to date for this project $74,000.

Amount expended thereon to date is $69,930.03, of which about $22,000 has been applied to construction and the remainder to maintenance. Operations during the year have been confined to maintenance by means of the snag-boat.

After an expenditure of about $5,000 for this purpose it became known that there would be no appropriation for the coming year; hence the balance of the appropriation was held in reserve, to put minor repairs on the snag-boat and do as much as possible in the maintenance of the channel for another season.

The snag-boat Corvallis being about worn out, it is quite necessary that another should be built at once. The operations of the snag-boat are extremely economical and efficient, and it will be sound policy to build a thoroughly good one.

Operations were resumed by the snag-boat September 15 and continued until December 19, when she was laid up for the season. On the 13th of June she was again placed upon the river for another season's work, after undergoing minor repairs.

During the year she has removed 1,332 snags from various points along the river as follows:

Month.	Number of snags removed.
1884.	
September	125
October	493
November	398
December, 1-20	172
1885.	
June, 19-30	144
Total	1,332

It is proposed to apply the appropriation asked for as follows:

Construction of new snag-boat	$28,000
Current operations for maintenance of C. Channel	12,000
Rock removal and wing-dams	7,000
Total	47,000

APPROPRIATIONS.

Act March 3, 1871	$16,000
Act March 3, 1873	3,000
Act June 23, 1874	7,500
Act March 3, 1875	25,000
Act August 14, 1876	20,000
Act August 18, 1878	20,000
Act March 3, 1879	12,000
Act June 14, 1880	12,000
Act March 3, 1881	15,000
Act August 2, 1882	5,000
Act July 5, 1884	10,000
Total	145,500

Money statement.

July 1, 1884, amount available		$0 54
Amount appropriated by act approved July 5, 1884		10,000 00
		10,000 54
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,930 57	
July 1, 1885, outstanding liabilities	675 25	
		6,605 82
July 1, 1885, amount available		3,394 72

Amount (estimated) required for completion of existing project:	
Construction	7,000 00
Snag-boat	28,000 00
Maintenance per year	12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	47,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

T T 2.

IMPROVEMENT OF THE COLUMBIA RIVER AT THE CASCADES, OREG

This is the name of the gorge through which the Columbia River effects the passage of the Cascade Mountains.

It is an extraordinary position. It is the key point in the commercial strategy of the Pacific Northwest. With its waters freely open to navigation, and with railroads along either bank, the whole region will be insured minimum freight rates, and there will result a development in population and material wealth such as is hard to realize. The greater part of the magnificent country drained by the Columbia River is cut off from a sea outlet by the north and south trending mountain mass of the Cascade Mountains. It is a broad, massive range capped with a layer of volcanic outpourings at least 4,000 feet thick, and dotted here and there along its axis with snow-clad cones, which reach altitudes equaling the highest points of the backbone ridge of the continent.

Through this great ridge no other pass exists at such an altitude as can hope to divert the east-west channel of commerce along the Columbia River. "The longest way around" through this horizontal pass will always be a shorter haul than any other line, plus the vertical distance over the mountains. A sketch map is herewith submitted showing the Columbia River region. Its area is estimated at 245,000 square miles. It drains the western slopes of the main range of the Rocky Mountains, its drainage basin extending between latitudes 41° and 53° north, or over 12 degrees of latitude. Owing to this great range in latitude, involving considerable variation in climate, an opportunity is afforded for an average in the water discharge of the lower river, and hence the annual flood presents itself with great precision in the month of June, but varying in quantity in a manner which depends upon the quantity of precipitation, and also upon the relative distribution of heat throughout the season.

The following tables of drainage areas are taken from Lieutenant Symons's report on the Columbia River:

DRAINAGE AREAS.

	Square miles
Oregon:	
Willamette (and Columbia below mouth of Willamette)	12,[illegible]
Des Chutes	10,[illegible]
John Day, Willow Creek, and Walla Walla	12,[illegible]
Snake River	17,[illegible]
Washington Territory:	
North side Columbia, below Snake	8,[illegible]
Columbia above Snake	30,[illegible]
Snake	5,[illegible]
Idaho:	
Columbia River	7,[illegible]
Snake River	70,[illegible]
Nevada, Snake River	6,[illegible]
Wyoming, Snake River	5,[illegible]
Utah, Snake River	7[illegible]
Montana, Columbia River	20,[illegible]
British Columbia, Columbia River	38,[illegible]
Total area drained by Columbia River	244,[illegible]

This is a larger area than all the New England and Middle States with Maryland, Virginia, and West Virginia combined.

For purposes of comparison I give their areas as taken from the last Census Report:

	Square miles
Maine	35,[illegible]
New Hampshire	9,[illegible]

	Square miles.
Vermont	10,212
Massachusetts	7,800
Connecticut	4,750
Rhode Island	1,306
Total	68,348
New York	47,000
Pennsylvania	46,000
New Jersey	8,320
Delaware	2,120
Total	103,440
Maryland	11,124
Virginia	38,348
West Virginia	23,000
Total	72,472
Grand total	244,260

I also give here for comparison the areas of the principal European countries:

	Square miles.
Great Britain and Ireland	121,230
France	201,900
Germany	212,091
Austria-Hungary	226,406
Italy	112,677
Spain	182,758

The drainage area of the Columbia may also be divided as follows:

	Square miles.
Snake River	104,604
Upper Columbia above junction with Snake	97,155
Main Columbia below junction	43,200
Total	244,959

THE GREAT PLAIN OF THE COLUMBIA.

Quoting again from Lieutenant Symons's report:

The northern portion of the interior Columbia Basin, known as the Great Plain of the Columbia, may be described as that area bounded on the west by the Cascade Mountains, on the south by the Blue Mountains, on the east by the Bitter Root and Cœur d'Alène Mountains, and on the north by the mountains of the Moses and Colville Indian reservations, and those in the triangular area between the Columbia and Clarke's Fork. This area is about 145 by 155 miles in extent, and contains approximately 22,000 square miles, or 14,080,000 acres, an area twice the size of Maryland, and as large as Massachusetts, New Hampshire, Connecticut, and Rhode Island together.

Over nearly the whole of this Great Plain of the Columbia there is now spread a rich and fertile soil, varying in depth from a few inches to hundreds of feet. This soil has been the product of the grinding action of the ice and drift of the Glacial epoch, by the water-wearing of the Champlain epoch, and from the disintegration of the rocks during the last and present existing Terrace epoch; by the action of summer's rain and heat, winter's frost and cold, and the chemical decomposition arising from exposure to the atmosphere.

An increase of moisture seems to come with an increase of cultivation, and every acre that is planted, tended, and harvested adds to the total agricultural acreage of the country and its capability of grain producing. This has been abundantly proven in Nebraska and other sections east of the Rocky Mountains. After Fort Kearny was established, in 1848, the Government employed a skilled farmer for years to live there and try to raise vegetables for the troops, and grain for the public animals. But agriculture was a complete failure owing to lack of rain. Now all about the old fort are thousands of farms on all of which abundant crops are raised. This change has been produced by the westward progress of settlements, carrying along an increased rainfall.

Since the date of this report it has been demonstrated that nearly the whole of this great plain is a magnificent grain-producing country, as the statistics submitted herewith will show. Furthermore, the soil is not only fertile, but of extraordinary endurance. In the Willamette Valley that fields have been continually cropped with wheat for twenty years are now yielding from 30 to 35 bushels per acre of winter wheat.

When it is considered that, in addition to its grain-producing capacity, this region has ample resources in precious metals, coal, iron, and most of the various products that go to make up that interweaving of a great variety of industries which always insures the development of wealth and prosperity, it becomes evident that the mountain gorge that commands the whole trade of such a country is worthy of considerable attention from Congress. The development of this region will add so rapidly to the material wealth of the nation, and add so largely to its revenues, that every dollar expended will come back many fold into the public Treasury.

The obstructions to navigation through this gorge occur at the *Dalles* and at the Cascades. At the latter place the works for improvement are approaching completion, and the following is submitted concerning said operations during the fiscal year just closed:

IMPROVING THE COLUMBIA RIVER AT CASCADES, OREGON.

The obstruction to navigation at this point is caused by a considerable contraction in the water-way of the river, extending over a distance of about 4½ miles, in the heart of the Cascade Mountains. This produces the strong rapids known as the Cascades of the Columbia, the water being dammed back until the slope becomes sufficiently increased to afford a velocity that will carry the discharge volume through the reduced channel-way. The slope produced by the damming of the waters is the greatest at the head, where the river makes a double rectangular bend around a rocky point on the Oregon shore. This point is called the Upper Cascades, and the remainder of the contracted water-way, about 3½ miles long, is called the Lower Cascades.

The plan of improvement is to flank the Upper Cascades with a canal 3,000 feet long, and to make the Lower Cascades navigable by clearing out islands, bowlders, rocky points, and submerged reefs by blasting, thus increasing and smoothing the water-way. As these latter operations would have a considerable effect upon the water-level at the foot of the canal, and as its quantity could not be foreseen, it has been necessary to defer the principal operations on the canal until after the river work was completed.

The operations of the current year have resulted in the substantial completion of the work upon the Lower Cascades, and it has resulted in such improvement as *to make them navigable at all stages of the river for lightly-laden boats, and at all stages, from low-water up to the stage of 24 feet at the foot of the canal, for laden boats.* There is much reason for congratulation upon these results, as will appear from an examination of the preliminary discussions of the project. The following data are interesting:

	Feet
Length of canal	3,000.0
Total fall of water-surface between head and foot of canal:	
At high water	11.0
At low water	.0
Distance by river	4,500.0
Total fall between head of rapids and foot of Lower Cascades:	
At high water	45.0
At low water	36.0
Distance	23,000.0

	Feet.
Total fall between foot of canal and foot of Lower Cascades:	
At high water	34.1
At low water	14.0
Distance	18,500.0
Difference between extreme high and low water:	
Head of canal	46.0
Foot of canal	57.0
Foot of Lower Cascades	37.4

An annual flood occurs with precision in June, producing a rise that varies between 30 and 57 feet at the foot of the canal, and at the head of the canal between 23 and 45 feet. It will be seen from these figures that lock construction in the canal will be attended with peculiar conditions involving considerable difficulty and expense. It has been decided to overcome the maximum difference of level with one lock, but as in order to meet the extraordinary variations of level, the walls and gates of a single lock would be unprecedented, it was thought better to resort to the device of a high-water guard-lock in addition to an ordinary lift-lock for low-water stages. The present plan of operations is to make the low-water lift-lock, and open the canal for navigation up to a stage of about 20 feet at its foot, deferring the construction of the guard-lock for the present.

It is proposed to apply the sum asked for to the construction of guard-gate, wing-walls, lock-walls, purchase of timber for gates, lock and canal pit excavation, and grading.

During the year work has been carried on in the construction of canal wall, the paving of canal slopes, excavation of canal and lock pits, grading grounds, quarrying stone from bowlders of porphyry rock, transporting quarried rock to site of work, cutting stone for canal walls, and rock-blasting in the rapids and along the shore of the Lower Cascades. For quantities and cost per unit of work reference is made to the complete and satisfactory statements in the report of Lieutenant Willard Young herewith. Particular attention is called to the extremely low cost of rock removal in swift water.

PROPOSED MODIFICATION OF PLAN.

The plan under which we are now working calls for canal and locks 90 feet wide, but with gates 70 feet wide.

The reduction in gate-span was made on the score of economy in gate construction. Now the introduction of 20-feet shoulders at every opening in the locks whose walls are so high as will be required here will make very serious obstructions to the passage of boats and craft which do not carry their own means of propulsion. At low-water stages, the busiest season, they will have to be handled by lines from the top of the lock walls at such a great altitude above them as to make it a very difficult, and unnecessarily difficult, matter. I therefore recommend that there be no reduction in the gate spans, and that a uniform width of 80 feet be preserved throughout the canal and locks. This will accommodate a side-wheeler of 79 feet width over all, or a tow-boat more than 45 feet wide with a 30-foot barge alongside of her, and will be an ample width of lock for any business which may develop on this river. A barge 30 feet wide will certainly be large enough for hauling in the swift water that will be met with.

I also propose that the lower lock be constructed to work up to a stage of 24 feet at the foot of the canal instead of to a 20-foot stage, as now contemplated. The reasons for this are as follows:

The river is now freely navigable to the foot of the canal up to a stage

— feet. The reason why 20 feet was fixed upon was that it was so hoped that navigation could be secured in the river below to a higher stage than that. Furthermore, the maximum lift is 24 feet, and hence by making the lower lock work to that height above low water only one lockage will ever be required after the guard-lock is constructed. Whereas if we construct this lock for a lower stage than 24 feet, there will be a period when *two* lockages will be required for getting the boats through.

These considerations are more than sufficient to call for the changes proposed, which do not, however, materially affect the project as adopted.

In conclusion, I will only add that if the necessary funds can be afforded, I can open this work to navigation inside of two years, and that every year saved in the opening of navigation through the Cascade Mountains will save to the masses of people affected a sum approximating the whole cost of the works.

APPROPRIATIONS.

Act June 14, 1876	$90,000
Act June 18, 1878	150,000
Act March 3, 1879	100,000
Act June 14, 1880	100,000
Act March 3, 1881	100,000
Act August 2, 1882	265,000
Act July 5, 1884	150,000
Total	955,000

For commercial statistics see letter of transmittal.

Money statement.

July 1, 1884, amount available		$5,697 15
Amount appropriated by act approved July 5, 1884		150,000 00
		155,697 15
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$131,064 15	
July 1, 1885, outstanding liabilities	2,809 33	
		133,873 48
July 1, 1885, amount available		21,823 67
Amount (estimated) required for completion of existing project		1,250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		750,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF LIEUTENANT WILLARD YOUNG, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cascade Locks, Oreg., June 30, 1885.

SIR: I have the honor to submit the following report of operations for the year ending June 30, 1885, upon improving Columbia River at Cascades, Oregon.

The improvement consists in providing a canal with locks around the upper or main rapid, and in so improving the lower or minor rapids by blasting, that boats can, with comparative safety, reach and leave the canal during all stages of the river for which lockage is provided

Thus far most of the work done on the canal and locks has been of a preliminary character, while awaiting the results of the open river improvement work.

This latter, so far as it affects the level of the lower approach, or reference of the lower miter-sill, is now so nearly completed, that there is no longer any reason, except the lack of funds, for delaying actual lock construction.

The present plan proposes a single low-water lock 462 feet long, 90 feet wide, and ith a lift of about 24 feet. The gates are to be constructed of wood.

The gates are to be but 70 feet wide. The foundations, walls, and culverts are to e built of concrete. The plan is so arranged that a high-water lock can be added, needed, in the future, or, if the difficulties of a high-water navigation should rove too great to warrant the building of another lock, so that a portage railway ay be conveniently laid to accommodate such traffic as will then be possible.

Owing to the very limited harbor room at the lower entrance to the canal, to the onstant swell in the lower canal, and especially to the great height of the canal and ock-walls, great difficulty will be experienced in handling and in moving boats in he canal and locks and in properly lashing and fastening together the boats of a leet after passing through the locks. It seems to me desirable and, indeed, almost mperative that the plan should be so modified as to do away with the projecting houlders at the gates. This could be done by widening the gate-span to 90 feet, by educing the width of the lock-chamber to 70 feet, or by adopting for both some intermediate width, as 80 feet. Unbroken fleets of boats could then pass through the ocks without being detained to break up the fleet before entering and again to lash and fasten the fleet together after passing through the locks, and while in the locks and canal the whole fleet would move as one boat.

To permit the widening of the gate-span, it is probable that steel gates would have to be substituted for the wooden ones now proposed. I am of the opinion, however, that a width of 70 feet for the locks will be ample.

All work done during the year, except on repairs to tow-boat, steam-launch, drill-scow, and wood-scow, has been by hired labor.

CANAL WORK.

(*a*) *Side walls on left at upper entrance:*

Length of wall built (except coping) during the year....feet..	50
Amount of dry cut-stone masonry laid in wall....cubic yards..	100
Amount of dry rubble-stone masonry laid in wall....do....	318
Total cubic yards laid....	418
Cost per cubic yard....	$5 92+

(*b*) *Paving slope of left bank above locks:*

Amount of dry-stone pavement laid....cubic yards..	1,235
Cost of pavement per cubic yard....	$4 09+

(*c*) *Excavation of lock-pit:*

Amount of rock excavated....cubic yards..	4,120
Amount of earth and gravel excavated....	8,673
Cost per cubic yard rock, earth, and gravel....	$0 62+

(*d*) *Grading grounds.*—The material excavated from the canal prism has been used in grading grounds on the left of the canal.

The stone-yard near the blacksmith-shop has been enlarged and graded up to the (114.0) level. A wide berme, extending from the postern of the upper guard-gate to near the stone-yard, and intended as a working level for further excavation, for transportation of material, and for the laying of lock-masonry, has been graded along the left bank at the (114.0) level. This, with the stone-yard and the bermes on the left of the lower and upper entrances, provides a nearly level roadway for the whole length of the canal. The bank opposite the lodging-house, and between it and the working berme just mentioned, has been graded up to the (130.0) level, and this provides considerable working and storage room in a convenient locality beyond the reach of high water.

Length of tramway built and used in grading grounds....feet..	1,827
Cost of grading per cubic yard of material moved....	$0 19+

(*e*) *Bowlder quarrying.*—Most of the quarrying for the year was done at the point on the right of the canal just below △ 4 L.

Some was done on the left shore below the locks, and a little in the canal pit while excavation work was being carried on.

Amount of stone quarried for cutting....cubic yards..	2,744
Amount of stone quarried for rubble-work....do......	4,765
Cost of quarrying per cubic yard of stone (dimension) obtained....	$3 45
Cost of quarrying per cubic yard of rubble-stone obtained....	2 82
Average number of feet drilled per day, per man, by quarrymen....holes..	72.33
Average price per day paid quarrymen....	$2 49

Rock, basaltic bowlders.

(*f*) *Transporting stone.* All the stone quarried during the year, together with some quarried previous years, has been transported to the site of the locks, and piled at convenient places, ready for use. Most of the stone for cutting is piled in the stone-yard at the (114.0) level, and the rest in the yard near the stone-shed. Of the stone intended for backing, paving, and rubble work, a part is piled on the protecting embankment on the right of the canal; and a part, within reach of fixed derricks, near the lower entrance to the canal. Besides the above, 39 cubic yards of stone for cutting were hauled to the stone-shed from the quarry, situated about one mile above the works.

It is hoped that the pile of stone on the protection embankment will, by its great weight, so consolidate the embankment as to stop, or at least greatly lessen, the leakage through it.

The length of tramway laid for transportation of stone was 1,764 feet, all of which has since been taken up, to preserve it from being carried away by high water.

Cost of transporting stone per cubic yard moved	$1 [illegible]

(*g*) *Stone-cutting:*

Face stone for side wall of canal	cubic yards	85[illegible]
Superficial cutting on above	square feet	38,2[illegible]
Linear feet of base course cut	feet	2[illegible]
Linear feet of 2-foot course cut	do	2,2[illegible]
Linear feet 31 feet 10 inches course cut	do	1,0[illegible]
Linear feet of 1 foot 8 inches course cut	do	1,3[illegible]
Total number of days' labor of stone-cutters	days	912.[illegible]
Average number of square feet cut daily, per man	square feet	41.[illegible]
Average number of cubic yards cut daily, per man	cubic yard	0.[illegible]
Average cost of cutting per square foot, stone-cutters' labor only		$0.[illegible]
Average cost of cutting per cubic yard, stone-cutters' labor only		3.[illegible]
Cost per square foot, including superintendence, handling, and piling, sharpening of tools, material, &c., exclusive of value of stone		.1[illegible]
Cost per cubic yard, including above items and exclusive of value of stone		5.[illegible]
Cost per cubic yard, including value of rough dimension-stone		10.[illegible]

(*h*) *Clearing away and piling stone at lower entrance to corral.*—This work consisted in removing two large piles of rock that had been dumped at the lower entrance to the canal before the present plan of improvement was adopted and while the work was in the hands of contractors; in cleaning the shore below the bulkhead of bowlders and clumps of bed-rock, and in piling the stone at convenient places ready for use.

Amount of stone thus moved and piled, about	cubic yards	3,[illegible]
Cost per cubic yard thus moved and piled, about		$1 [illegible]

(*i*) *Side wall of right at lower entrance.*—Excavation work for this wall was commenced in November, and carried on till the middle of December, when it had to be abandoned on account of severe weather and snow-storms. Great drifts of snow accumulated over the site of the work; and it was so late before these disappeared that it was thought unadvisable to continue the work this season.

The cost of this work is included in the item "Excavation" in the detailed statement of expenditures below; and the amount excavated (1,214 cubic yards) is included above under the item "Excavation of lock-pit."

(*j*) *Buildings.*—A new cement storage-house of 2,000 barrels capacity, situated a little east of the stone shed, has been built and completed, all but the flooring, and battening. Cost to date, $828.05.

A neat little railroad station-house, presented by the merchants of Portland, Oreg., to the employés of the locks, in recognition of their services during the great storm of last winter, in carrying provisions to snow-bound trains, and in helping to open the blockade, has been erected, by permission, on Government land. The building is now used as a waiting-room, post-office, and express office, and is considered as belonging to the works. The upper story has been fitted up at Government expense, as quarters for the attending physician. Cost to the Government, $86.96.

The carpenter shop has been moved from its old position in the hollow to a more convenient location, on top of the bank, at railroad grade. This had to be done to permit the grading of the old site up to the (130) level. Cost of moving shop, $117.2[illegible]

Repairs of a more or less extensive character have been made, as needed, to the various buildings occupied as quarters, and to the office, mess and lodging houses, powder-houses, hospital, and commissary building, stone shed, and blacksmith shop. The total cost of expenditures below, under its proper heading.

(*k*) *Plant.*—The plant generally, including that on the canal and on the river, has been kept in good order. A machinist was employed during the busy season to look after and keep in repair the hoisting-engines, steam-drills, and other machinery.

Some new plant has been manufactured, including several new stationary derricks and a number of tools for use in the blacksmith shop.

The large centrifugal pump, for pumping out the canal-pit, has been repaired and put in good working order. The slipping of the wire rope on the drive-wheels, which has heretofore always interfered with the proper running of the pump, has been entirely prevented by using ordinary rubber hose, split in half, as packing.

Extensive repairs were made early in the season to the tow-boat, launch, drill-scow, and wood-scow, to fit them for use on river-improvement work. The cost of these repairs is given in the statement of expenditures below.

(*l*) *Protection of property.*—During the floods of summer most of the works are covered with water, so that all plant and material liable to damage have to be moved each year to high ground.

All has again to be moved into position, on the subsidence of the water, before work can be resumed. This adds very much to the cost of the work. A further expense has been incurred this year in securely housing hoisting-engines, derrick booms and masts, and other material liable to damage on long exposure to the weather. This has been rendered necessary by the failure of Congress to appropriate funds for continuing the work. Parts of machinery necessarily exposed, iron work, &c., liable to damage, have been painted, and care has been taken generally to protect all plant and material as much as possible from deterioration during the enforced suspension of the work.

(*m*) *Miscellaneous.*—For the convenience and safety of boats coming to the locks at different stages of the river, a floating landing-stage, consisting of a raft of large timbers, with mooring and fender posts, all securely framed together, has been constructed and moored at the foot of the canal. Cost, $349.76.

Operations, both on the canal and river, were necessarily suspended for a considerable time during and after the great storm of last winter. This storm, which commenced about the middle of December, lasted for three weeks, and was of unusual severity. Snow fell at this place to a depth of 8 feet on the level; and in places was blown into drifts of immense depth, which completely buried parts of the work, and for a long time prevented the resumption of work. The river was closed by ice, and the railroads were, for a long time, completely blockaded. Considerable difficulty was experienced in getting provisions for the men and for blockaded passengers detained here. Many of our hands fortunately found employment, at good wages, in shoveling snow for the railroad company.

The rainfall, height of water, &c., for each month of the year, are given in the following table:

Months.	Rainfall.	Days on which it rained or snowed.	Average temperature at 1 p. m.	Highest reading above extreme low water.		Lowest reading above extreme low water.	
				Head of canal.	Foot of canal.	Head of canal.	Foot of canal.
1884.	*Inches.*	*Number.*	*Degrees.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
July	1.08	6	71.4	122.3	107.8	110.5	93.2
August	....	....	79.0	110.6	93.0	105.0	85.4
September	6.38	10	62.2	105.1	85.4	100.8	78.8
October	10.22	14	54.5	102.5	81.7	100.0	77.9
November	4.8	9	50.5	103.0	82.1	100.8	77.8
December	15.42	21	24.2	99.9	77.5	92.7	*73.7
1885.							
January	5.45	9	30.9	100.8	*80.5	97.1	73 7
February	16.72	22	58.4	104.8	85.1	98.8	76.0
March	1.6	6	58.9	106.5	87.5	102.4	81.4
April	.78	6	61.03	110.1	92.7	106.2	87.0
May	4.6	13	64.3	116.54	101.65	107.4	88.7
June	1.55	9	66.45	118.54	103.9	114.64	99.15
Total	68.6	125	56.8	....	....	....	....

* Ice-gorge.

The following statement shows the average number of men per day employed during each month of the year:

Month.	Canal work.	River work.	Total.
July	13.9	1.1	[illegible]
August	58.8	4.2	[illegible]
September	128.4	18.4	[illegible]
October	159.3	42.7	[illegible]
November	156.8	36.8	[illegible]
December	90.4	22.9	[illegible]
January	33.0	23.5	[illegible]
February	83.9	21.1	[illegible]
March	86.51	0.6	[illegible]
April	34.3	....	[illegible]
May	19.19	....	[illegible]
June	25.98	....	[illegible]

RIVER WORK.

River improvement has extended this year from the main falls opposite the Locks to the foot of Old Garrison Rapids, as shown on the accompanying map; and has consisted of the drilling and blasting of bowlders and masses of conglomerate and hard rock, along either shore; and in blasting, either by submerged charges, or after drilling, of rocks and clmps of reefs in the channel-way of the river itself.

The methods and appliances used were, practically, the same as those described in previous reports, only that a greater familiarity with the work permitted a more advantageous arrangement of details and a more vigorous prosecution of the work.

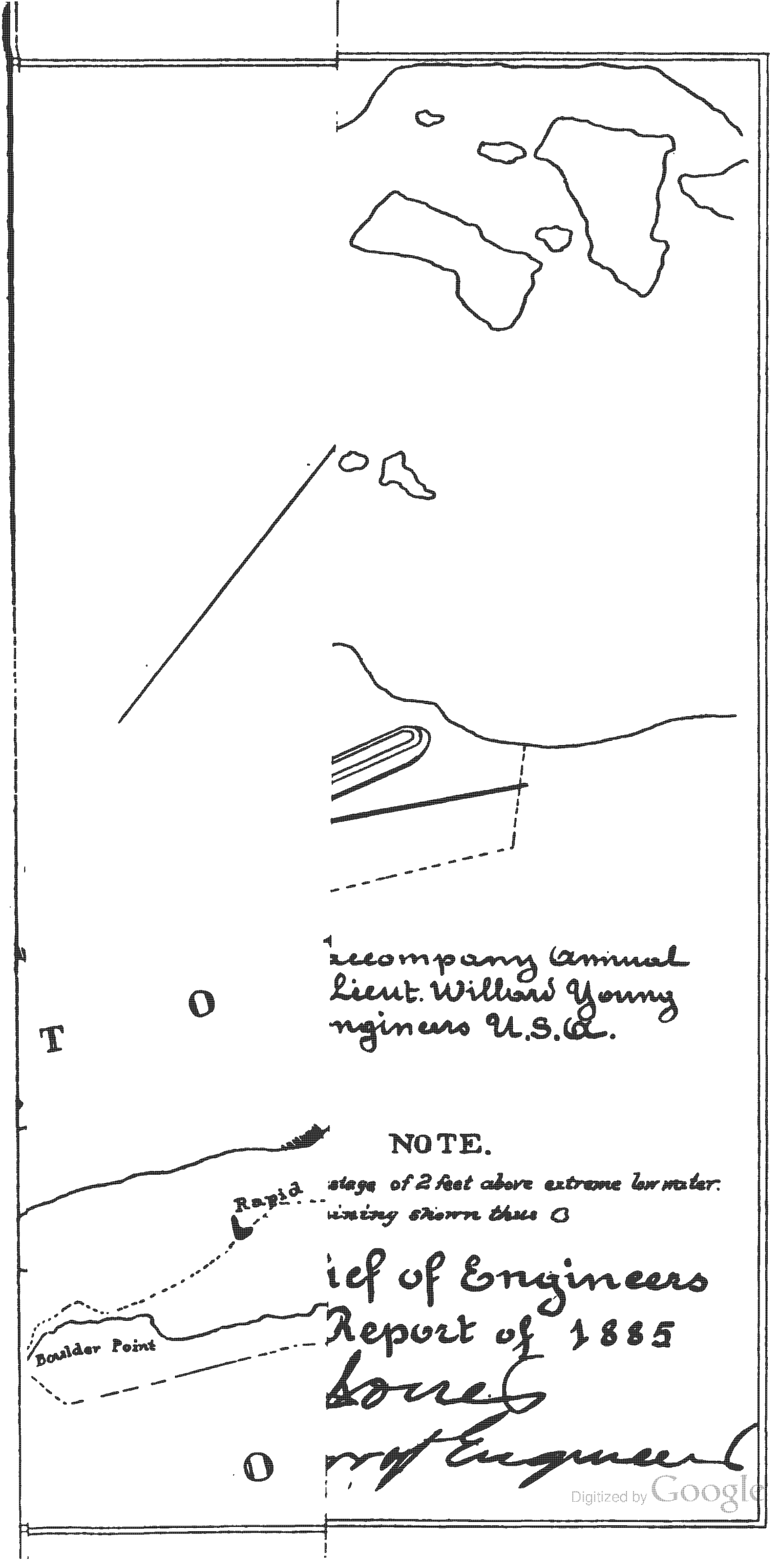
The tow-boat and drill-scow, after undergoing extensive repairs in Portland, reported here for duty in the latter part of August. The small steam-launch was brought down over the falls, during high water in July, at considerable risk, for service on river-improvement work. The tow-boat was employed in blasting on Big Eddy Reef, and in transportation work, and in attendance on the Chief of Engineers and party, until October 31, when she was sent to the mouth of the Willamette, for work there and on the Lower Columbia. The accompanying map shows the portion of Big Eddy Reef attacked.

It consisted of a broad flat shelf of bed-rock, over which water from 8 to 12 feet deep was running at a rate of about 15 miles an hour at the time the blasting was done.

The plan adopted for removing the reef was simply to mash it down by firing large charges of dynamite resting directly on top of the rock. The tow-boat was used in lowering the charges, which consisted usually of 400 pounds of 72 per cent. dynamite. Lines leading from the tow-boat to a securely-anchored scow in the eddy above, and to the shore, enabled her to place herself at any desired point for sounding and lowering the charges. The charges, besides being heavily weighted, had to be held in position by lead lines from the scow above, to keep them from being swept away by the swift current. The submerged charges were fired from the scow above by sending down along one of the lines a properly-arranged exploder, with lighted fuse attached. A very considerable improvement to the rapid was at once effected by the work.

The drill-scow was employed during the whole low-water season in steam drilling at various points along the river; and at the close of the season was sent to Portland along with the steam-launch for safe-keeping. The launch did excellent service during the whole year as tender to the drill-scow and in waiting on the force of gang drillers on shore.

The results of the season's operations are shown in detail in the following table and the accompanying map, where are given the location of the reefs and bowlders attacked, and the amounts broken up and removed in each case, as well as the cost of the improvement and of the different kinds of work.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Boulder Point
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Report of 1885
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[Extract.] *Detailed statement of cost of river work, season 1884-'85, Cascades Canal, Oregon.*

Character of work.	Shore work.			River work.						Repairs to tow-boat.	Totals.
	Washington Territory shore.	Oregon shore.	Foot of Bradford's Island.	Sheridan Rapids.	Big Eddy Reef.	Along Washington Territory shore, Big Eddy Point, and Middle Block-house Point.	Middle Landing.	Rock Island Bowlder.	Garrison Rapid.		
Dynamite, fuze, caps, &c	$3,205 17	$416 44	$1,252 39	$2,968 07	$5,423 17	$789 16	$1,697 98	$121 79	$847 51	....	$16,721 68
Gang drilling	4,965 66	1,675 34	246 16	8 16	....	....	8 16	....	....	....	6,903 48
Block drilling	181 97	123 17	96 37	....	....	....	....	....	....	....	401 51
Steam	1,897 06	....	1,137 51	1,514 19	....	....	686 33	79 51	189 05	....	5,508 65
Blasting	485 63	168 18	132 04	274 25	800 54	135 54	90 28	7 05	1 86	....	2,045 87
Rope blasted away	....	....	....	12 83	82 67	14 13	....	....	....	....	109 63
Plant dropped from return	185 20	5 77	102 85	137 19	29 85	5 90	59 70	6 68	16 19	....	549 88
Repairs to tow-boat	....	....	....	....	....	....	....	....	....	$3,513 56	3,518 56
Totals	10,870 69	2,388 90	2,967 32	4,914 69	6,336 23	944 73	2,542 45	215 03	1,054 61	3,513 56	35,748 21
Total cost per cubic yard blasted	1 04	1 59	96	91	15 84	4 10	1 02	55	1 17	....	....
Cost per cubic yard for powder, fuze, &c	30½	27¾	40½	55	13 56	3 42½	66½	31	94	....	....

The cost given in the above table includes maintenance of plant and all running expenses and repairs to drill-scow, steam-launch, and wood-scow during the year. The cost of repairs to tow-boat has not been apportioned, because so small a portion of her time was spent on this work.

Average number of feet drilled per day by each gang of drillers	14.43
Average number of feet drilled per day by block driller	13.9[illegible]
Average number of feet drilled per day by steam-drill	4[illegible].[illegible]
Cost per foot drilled by gang drills	$0 64
Cost per foot drilled by block drills	1 4[illegible]
Cost per foot drilled by steam-drills	.30
Cost per cubic yard broken up, gang	1.66
Cost per cubic yard broken up, block	.36
Cost per cubic yard broken up, steam	.35

The steam-drills used were the improved Ingersoll, 13½ inches, drilling holes 2½ inches diameter on top and reducing to 2 inches diameter at bottom of 21-foot holes. On large rocks, round and not too irregular surface, these drills averaged 75 feet per day, one day reaching 113 feet per drill. The broken time caused by severe weather and ice increased the cost of steam drilling nearly 20 per cent.

Neither the work of *bowlder quarrying, nor of clearing away and piling stone at lower entrance to canal,* described above as under "Canal work," is here included, though really a part of the project for river improvement. Indeed, the above work has resulted in considerable improvement to the river at the crossing from Big Eddy to the foot of the canal. By the peculiar conformation of the shore on either side of the main rapid the water is deflected from both sides toward the center, so that the main flow of the river is through a narrow funnel-like chute, which causes the water in the center to pile up much higher and to run much swifter than at the sides. The effect of this season's work has been not only to make the entrance to, and landing at, foot of the canal more safe, but also to materially widen the rapid for medium stages of the river, and thus reduce the current at the center, and make it more uniform over the whole width of the river at the crossing to the locks.

In some cases during the progress of the season's work the masses of rock attacked were at once leveled down or thrown into deep water, while in others they were only broken up into small fragments and left to be carried away by the current at high water.

In the first case, any improvement resulting from the work was at once evident; while in the second, at least one season of high water must intervene before the results can be definitely stated.

It is gratifying to know that most of the broken rock on Big Eddy Reef blasted in the winter of 1883–'84 has been carried away by the current. Some clumps yet remain; but that a very great improvement has resulted from the work is unquestionable. Even at extreme low water, when the rapid is at its worst, the little steam-launch belonging to the works passed through it to the foot of the canal. The general improvement to the river below the canal, resulting from this and previous season's work, is so great, that the further prosecution of river work is unnecessary and unadvisable until after the opening of the locks, except to take advantage of favorable seasons of extreme low water to do work that is only then possible. It has been practically demonstrated by the repeated trips of the Government tow-boat and launch to the locks at various stages of the river, that navigation through the lower rapids is both possible and comparatively safe for all stages of the river up to and even somewhat beyond a 20-foot rise. For the higher stages of the river much work is yet needed to make navigation practicable, and for the very highest stages no amount of open river work will suffice to make it so.

The interests of this part of the country can now be best served by hastening to completion the construction of the low-water lock, so as to open the river to trade at the very earliest time possible. Practical navigation will then point out better than can now be told just what further improvement will be necessary.

The following detailed statement* shows the money expenditures and the cost of the various items of canal and river work during the fiscal year.

During my absence from the locks, from July 28 to August 16 and from November 24 to January 13, the general charge of the work fell to Assistant Engineer F. J. Carrel, who showed excellent judgment and commanding energy in his administration, especially during the time of the great snow blockade. Thanks are due him for his faithful services at all times, and also for many valuable suggestions.

The force and operations on the river were under the immediate charge of Draughtsman A. J. Brownlie, to whom great credit is due not only for intelligent and energetic supervision, but also for complete and valuable records of the work under his charge. Owing to the failure of Congress to appropriate funds for continuing the work, both of these gentlemen were, by your orders, discharged on April 16.

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* Omitted.

Very respectfully, your obedient servant,

W. YOUNG,
First Lieutenant of Engineers.

Maj. W. A. JONES,
Corps of Engineers, U. S. A.

T T 3.

IMPROVEMENT OF UPPER COLUMBIA AND SNAKE RIVERS, OREGON AND WASHINGTON TERRITORY.

The plan of this improvement consists in rock-blasting and bar-scraping removal to secure a low-water channel of 5½ feet in the Columbia as far as Ainsworth and 4½ feet in the Snake as far as Lewiston. The original estimate of cost is $132,000. Total appropriation on this project, $112,000. The project covers the Columbia River from Celilo, Oreg., to the mouth of the Snake at Ainsworth, and the Snake from this point to Lewiston, Idaho.

For the Columbia River above the mouth of the Snake no estimate is presented pending the results of the survey of Priest Rapids now under way.

OPERATIONS DURING THE YEAR.

All work has been done by contract, but owing to the unfavorable season but little has been accomplished.

The contract with Mr. F. T. Dodge, which expired October 31, 1884, was extended by the Chief of Engineers until April 30, 1885, and afterwards to March 31, 1886.

A contract was entered into with Mr. Silas R. Smith for rock, cobble-stone, and gravel removal on Snake River between Walker's Landing and the mouth of the river. Contract expires October 31, 1885.

Another contract was made with Holmes & Spencer for rock, cobble-stone, and gravel removal on Snake River between Lewiston and Riparia. Contract expires October 31, 1885.

The work on this river is very difficult, owing to the extremely swift water, and can only be prosecuted at favorable stages near low water. Owing to an extraordinary storm which closed the river with ice before the low-water stage was reached, but little work was accomplished, Mr. Smith being far more successful than the other contractors.

Before the ice moved in the spring the river had risen so as to require a postponement of operations until another low-water season.

It is proposed to apply the appropriation asked for to the removal of rocks and cobble-stone bars to the completion of the project.

Abstract of operations.

Locality.	Contractors.	Cubic yards.	Rock or gravel.	Cost per yard.
Lower Log Cabin Rapid	F. T. Dodge	6.67	Rock	$12 00
Rapid above White's Ferry	Holmes & Spencer	19.69	do	18 00
Do	do	50.00	Gravel and cobble	6 00
Bar below Jim Ford's Island	S. R. Smith	31.47	Rock	19 00
Rapids at Copely's Cut-off	do	6.42	do	19 00
Do	do	4.77	do	25 00
Fish-Hook Rapids	do	488.45	do	19 00
Total		607.47		
Total of gravel		50.00		
Total of rock		557.47		

I would very strongly recommend that after these contracts expire this work be done by hired labor.

I am quite confident that the Government can do it very much cheaper than it can hire others to do it. The use of large quantities of high explosives in very swift water, and the removal of cobble-stone bars in such water, involves skill and experience that is not gained in any of the ordinary private operations of the day. The work at the Cascade Locks has developed a force of trained workmen who can be used by the Government at great advantage on similar work hereafter.

APPROPRIATIONS.

Upper Columbia River:	
Act June 10, 1872	$50,000
Act June 23, 1874	20,000
Act March 3, 1875	35,000
Upper Columbia and Snake rivers:	
Act August 14, 1876	15,000
Act June 18, 1878	20,000
Act March 3, 1879	20,000
Act June 14, 1880	15,000
Act March 3, 1881	15,000
Act August 2, 1882	6,000
Act July 5, 1884	20,000
Total	111,000

Money statement.

July 1, 1884, amount available		$1,924 46
Amount appropriated by act approved July 5, 1884		20,000 00
		21,924 46
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$12,247 71	
July 1, 1885 outstanding liabilities	1,277 96	
		13,525 67
July 1, 1885, amount available		8,398 79
Amount (estimated) required for completion of existing project		36,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887.		36,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of contracts.

No.	Names and residences of contractors.	Date of contract.	Expiration of contract.	Subject of contract.
1	Frank T. Dodge, Portland, Oreg.	June 21, 1883	*Dec. 31, 1883	Removal of solid rock, cobble-stone, and gravel from channel of Snake River.
2	Joseph Kellogg & Co., Portland, Oreg.	Aug. 15, 1884	Apr. 30, 1885	Wing-dam construction, snagging operations, and maintenance of an [illegible]-foot channel free from obstructions.
3	Holmes & Spencer, Portland, Oreg.	Sept. 25, 1884	Oct. 31, 1885	Removal of solid rock, cobble-stone, and gravel from channel of Snake River.
4	Silas R. Smith, Ainsworth, Wash.	Oct. 31, 1885	Oct. 31, 1885	Do.

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*Extended to March 31, 1886.

T T 4.

IMPROVEMENT OF COWLITZ RIVER, WASHINGTON TERRITORY.

The plan of the improvement of this river consists in wing-dam construction, bar-scraping, and snagging operations to secure light-draught navigation up to Toledo, a little more than 30 miles above the mouth.

The original estimated cost of this work was $3,000 for the first year and an annual expenditure thereafter of $2,000 for maintenance. The total appropriation up to date has been $6,000. The amount expended to end of fiscal year is $5,988.13.

The sum of $2,000 was appropriated by the act of July 5, 1884. The operations under this have been entirely by contract. Contract was made with J. Kellogg & Co. (dated August 15, 1884) for building 300 feet of wing-dam at Batteau Rapids and for monthly maintenance of channel free of snags.

This contract expired April 30, 1885. Work has been satisfactorily done, resulting in a good improvement to navigation.

The work of improvement on this river has made a commercial development very large in proportion to the sum expended, and I am of the opinion that operations should be extended to Klikitat Bridge, about 20 miles further up the river, and also to include shore protection wherever it may become necessary to prevent the river from making its channel too wide. The estimate submitted has this extension in view:

APPROPRIATIONS.

Act June 14, 1880	$2,000
Act March 3, 1881	1,000
Act August 2, 1882	1,000
Act July 5, 1884	2,000
Total	6,000

Money statement.

July 1, 1884, amount available	$2 73
Amount appropriated by act approved July 5, 1884	2,000 00
	2,002 73
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,990 86
July 1, 1885, amount available	11 87
Amount (estimated) required for completion of existing project	3,000 00
Annual maintenance	3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	6,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

T T 5.

IMPROVEMENT OF LOWER CLEARWATER RIVER, IDAHO.

The plan here is to make a channel through rock-reefs and cobblestone bars over a distance of 40 miles above Lewiston, to secure a depth of 4 feet at low water. The original estimated cost was $34,424; total appropriation to date, $15,000; total expenditure, $15,000.

No appropriation was made by act of July 5, 1884, and no funds were available at the time the work was turned over to me. I have therefore no operations to report during the fiscal year.

In the face of the imperative and more important needs of this region for an outlet through the Columbia River Pass, and the expensive character of the work compared with any prospective development of commerce, I am not prepared to recommend the continuation of this work at the present time.

APPROPRIATIONS.

Act March 3, 1879	$5,000
Act June 14, 1880	5,000
Act August 2, 1882	5,000
Total	15,000

T T 6.

PRELIMINARY EXAMINATION OF SNAKE RIVER BETWEEN LEWISTON AND MOUTH OF BOISÉ RIVER, IDAHO.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., November 5, 1884.

SIR: I have the honor to make the following report of examination of Snake River between Lewiston and mouth of Boisé River, Idaho, in accordance with act of Congress July 5, 1884, and your letter July 31, 1884, to Capt. C. F. Powell, Corps of Engineers, Portland, Oreg.

Examinations of this portion of the Snake River have been made as follows:

Between Lewiston and Salmon River, by Lieut. Thomas W. Symons, Corps of Engineers, in August, 1881. (See Annual Report Chief of Engineers, 1882, Appendix O O 14, page 2718.)

Between Olds's Ferry and mouth of Boisé River, by Mr. F. J. Carrel, assistant engineer, acting under my direction, in October, 1884, whose report is submitted herewith.

Also a report of examination from Lewiston to mouth of Salmon River, Idaho, was made by Capt. Charles F. Powell, Corps of Engineers, under date of November 30, 1881. (See Annual Report Chief of Engineers, 1882, Appendix O O 14, page 2716.)

As these printed reports are easy of reference, they are not reproduced here.

Commenting upon the above information, I have to observe that the portion of the Snake River under examination is divided into three parts:

(1) From the mouth of the Boisé River down to the Grand Cañon.
(2) The Grand Cañon to the mouth of Salmon River.
(3) From the mouth of Salmon River down to Lewiston.

In 1 it appears that vessels drawing 2 feet of water can navigate during medium and high stages of water. There is no commerce on it now, and it will not be possible for any that the future may develop to get farther down than the Grand Cañon. Along this reach vessels drawing 2 feet of water at medium and high stages of the river will, in my judgment, be able to handle such business as may develop for a considerable period to come. Hence I conclude that it is not worthy of improvement, concurring with the opinion of Mr. Carrel.

In 2 it appears that the river is neither worthy nor possible of improvement.

In 3 it appears that the only commerce present and capable of future development must proceed from the Salmon River country and the Grande Ronde Valley.

From the former I have no information further than that an outlet by way of Salmon River is out of the question. From the latter the only outlet is by way of Ten Mile Creek, but from this point down the river there is no serious obstruction. Hence I conclude that the Snake River between Lewiston and the mouth of Boisé River, Idaho, is not at present worthy of improvement.

Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. F. J. CARREL, ASSISTANT ENGINEER.

CASCADE LOCKS, OREG., *October* 29, 1884.

SIR: Acting under your instructions dated October 18, 1884, I have made an examination of a portion of Snake River included between the mouth of Boisé River and Olds's Ferry, a distance of about 70 miles. I proceeded no farther down the river, because to have done so would have required considerable time and would have rendered necessary the services of a well-equipped surveying party.

Your instructions as subsequently modified limited the work to a general examination or rough reconnaissance of the Snake River and adjacent country from the Boisé River northward.

The Oregon Short Line Railroad Bridge crosses the Snake River about 4 miles below Olds's Ferry and about 55 miles above the Grand Cañon. The river between Olds's Ferry and the Grand Cañon is reported to be navigable; the Grand Cañon and Rapids below are considered impracticable for navigation. (See Report of Chief of Engineers, 1882, Part III, page 2716.)

Starting at Olds's Ferry and going up the river (or southward) a distance of 4½ miles, the first and only serious obstruction to navigation consists of a natural weir, or submerged dam, of cobble-stones and bowlders, which makes out from the right bank (Idaho shore) and extends very nearly the whole width of the river, which is here nearly one-half mile wide. At low stages no navigation is possible without improvement; at medium and high stages a narrow and swift current sets on the Oregon shore, which is not impossible for navigation by powerful boats of light draught, say about 2 feet.

I estimate that to improve navigation by removing the comb of the weir on the Oregon shore so as to enlarge the channel would cost from $3,000 to $3,500. This amount includes the necessary cost of building a small scow to carry out the work.

Continuing up the river from this point there is no other serious obstruction as far as the Boisé River, a distance of about 56 miles.

The surface velocity is generally from 3 to 4 miles per hour. Numerous shoals and gravel banks occur, and a very general feature is the division of the river into two channels by long and narrow central islands, formed by sand and gravel and covered with willow brush.

There are no settlements along the river. The land on each side is generally mountainous or else consists of high gravel land covered with sage brush and of no value without irrigation. On the right bank or Idaho shore the Fayette River enters about 20 miles below Boisé River, and the Weiser River about 18 miles below the Fayette. The Weiser Valley is about 25 miles long, and is said to be very productive with irrigation.

Considerable works of irrigation are being planned. At present no large area is under cultivation. From the mouth of the Fayette to Boisé River a strip of valley land about 4 miles wide is known as the Whitney Bottom, and is said to be productive.

In 1867 a small stern-wheel steamboat called the Shoshone was built for Captain Ainsworth, to ply upon the Snake River from Olds's Ferry to about 70 miles above the Boisé River. I am informed by Captain Hyrick, who ran the boat, that her length was 145 feet, beam 30 feet, and draught, loaded, about 2 feet. The Shoshone was the first and only steamboat which has navigated this part of Snake River. One season's run showed her owner that profitable navigation was not possible, even with the high rates for teaming then current, and this because there is naturally no settlement along the river banks.

Navigation upon this part of the river is as open now as when the Shoshone made her profitless trip, but there is still no traffic or commerce of any kind.

All this part of Oregon and Idaho is a mountainous, treeless region. The plentiful bunch grass of the foot-hills affords excellent range for stock; the hills are rich in minerals, and the valleys and plains, which are now covered with sage brush, can be made very productive by irrigation. But these conditions were not favorable to such a growth of commerce as to call for the immediate opening up of a river highway. At present all agricultural products find a ready market in the adjacent mining regions, and there is no export.

I conclude that it would be possible to open the river from the Boisé to the Grand Cañon at small expense, but that it would not be expedient, and that it might be expedient to open the river from the Grand Cañon to Lewiston, but it would not be possible.

By means of suitable letters of introduction to the most prominent commercial men of the part of the country likely to be benefited by increased means of transportation, I obtained much information as to the productiveness of the country and the extent of commerce likely to be developed by the opening up of the river. I found that these good citizens were as willing to have Congress spend money in improving the river as to have gold rained from heaven upon their section of the country; the total benefit in either case would be measured by just that portion of coin which each individual could obtain for his own pocket.

I have the honor to be, your obedient servant,

F. J. CARREL,
Assistant Engineer.

Maj. W. A. JONES,
Corps of Engineers.

TT 7.

PRELIMINARY EXAMINATION OF CŒUR D'ALENE LAKE AND RIVER, AND SAINT JOSEPH'S RIVER, IDAHO TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., November 14, 1884.

SIR: I have the honor to make the following report of an examination of Cœur d'Alene Lake and River, Idaho, and Saint Joseph's River, Idaho, in accordance with act of Congress July 5, 1884, and your letter of July 31; 1884, to Capt. Charles F. Powell, Corps of Engineers, Portland, Oreg.

I made the examination in person immediately upon taking charge of this district, but owing to the short time at my disposal it was not as complete as could have been desired.

Cœur d'Alene Lake is probably a fissure crater, a dead factor in the tremendous volcanic activity that once existed in this region. It is narrow, long, and of extraordinary depth. The bottom near the shore-line is precipitous, so that boats can land freely almost anywhere. Its length from the outlet into Spokane River to the mouth of Saint Joseph's River is about 30 miles. It is perfectly free from obstruction and navigable the whole distance.

About 24 miles from the outlet at Spokane River the Cœur d'Alene River enters the lake substantially at right angles to the movement of its waters towards the outlet. The change of direction has produced a bar in the lake opposite the mouth of the river. This bar is about 300 yards across and has a layer of soft mud on the top about 2 feet in thickness. At low water the depth of water on the bar is 16 inches. The mud being very soft, can be scraped and sluiced into the deep water of the lake at a comparatively slight cost.

I would recommend the removal of about 2 feet of it over an area 300 yards long by 50 yards wide. This will give a sufficient depth of water for all practical purposes. The Cœur d'Alene River has some very marked characteristics. Below the Mission Cœur d'Alene it is like a magnificent canal with a width varying between 100 and 150 feet, and a tolerably uniform depth of about 30 feet, over the greater part of said width. Above the Mission it is an ordinary mountain stream, shallow and with great velocity of current. It approaches the Mission with considerable velocity and passes suddenly into the deep water portion with a sudden and almost total loss of velocity. In ordinary stages this remaining velocity of current is about one-fourth mile per hour. It would seem as though the river below the Mission was a crack radiating from the fissure crater now occupied by the lake. In this reach the only obstruction to navigation is a few snags near the Mission. These can be removed at a small cost. The length of this portion of the river is 36 miles. The distance from the lake outlet at Spokane River to the Mission Cœur d'Alene is 60 miles. The river for some distance above the Mission is susceptible of improvement by removing snags, and light-draught boats could ascend this portion. The commerce over this portion will be the products of and supplies for the mining region just above, and the products of the fine timber forest about the headwaters of the river.

There has been considerable gold shipped from the Cœur d'Alene mines, but I was not able to get any exact statement concerning it.

The Saint Joseph's River is another tributary of Cœur d'Alene Lake, entering at its southern extremity. It is quite similar to the Cœur d'Alene. For 40 miles up from its mouth it has the same deep, canal-like character. It is obstructed with a good many snags, which I estimate can be taken out in about ten days. The whole work of clearing the snags out of both of these rivers, and deepening the channel through the soft mud of the bar at the mouth of the Cœur d'Alene River, I estimate can be done in about thirty days, at a cost of $3,000. No survey is necessary. There are three steamboats on these waters. One belongs to the United States Army, and was built by the troops at Fort Cœur d'Alene. It is used in bringing down forage supplies and lumber from the upper rivers. The lumber is sawed at a mill built and worked by soldiers from the same command. Another of these boats is a large and handsome steamer, such as now ply on the Upper Willamette River.

The trade is of too recent development to enable me to obtain exact commercial statistics.

The proposed improvements in navigation will form an outlet for the products of a large area of very fine agricultural, mining, and timber country.

The forests about the headwaters of the Saint Joseph's River are very extensive, and rich in magnificent specimens of red and white pine, cedar, red and white fir, and tamarack.

I therefore conclude that Cœur d'Alene Lake and River and Saint Joseph's River are worthy of improvement, and recommend an appropriation of $3,000 for that purpose.

Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

T T 8.

PRELIMINARY EXAMINATION OF LEWIS RIVER, WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., November 13, 1884.

SIR: I have the honor to make the following report of examination of Lewis River, Washington Territory, in accordance with act of Congress July 5, 1884, and your letter July 31, 1884, to Capt. Charles F. Powell, Corps of Engineers, Portland, Oreg. As Captain Powell's report of January 9, 1883, is sufficient in this case, I quote it in full:

LEWIS RIVER.

Lewis River, except the Cowlitz, is the largest tributary of the Columbia River below the Willamette; it rises near the foot of Mount Saint Helen's, of the Cascade Range, flows westerly and reaches the Columbia 13½ miles from the Willamette; it is formed by branches called the North and East forks, which unite 3 miles above the mouth of the main river.

The North Fork is the larger and more rapid branch. During mean and high stages small river-boats can ascend to Cedar Creek, about 10 miles above the junction of the forks. There are three riffles and two shoals of light material on this part of the North Fork, which prevent navigation during low stages. Small settlements exist above Cedar Creek, but the stream is too rapid and obstructed by bars of heavy material to afford navigation. Valuable cedar and white pine, as well as fir, are reported to abound on the headwaters. As it is a mountainous stream, snow floods occur in summer as well as rain freshets in winter. There is a small saw-mill at Cedar Creek.

The East Fork is smaller and more sluggish. Its average width is 100 feet. Tide extends 3 or 4 miles above La Centre. This place is the head of navigation, and is about 9 miles above the junction of the forks. At low stages, from lack of water, freight is taken to Pekin, at the junction, on flat-boats, and there loaded on the steamer. The East Fork is subject only to rain freshets. In the region of the forks and on the lower stream the country is open, and comprises good prairies and fertile bottoms. During the Columbia floods of summer the bottoms are submerged.

The population of the valley is from 2,500, to 3,000, and is steadily increasing. Productions consist of farm and garden produce, hay, fruit, and beef cattle. All trade is with Portland, Oreg. One steamer, the Latona, of 50 tons capacity, plies on the route; she makes three round trips weekly; her owners are building a new and larger steamer for the trade. They decline to give any statement of the traffic, for the reason, it is thought, of preventing publication and attracting notice of its profits.

On the lower 6 miles of the river navigation is impeded, and the use of large boats prevented by drift and snags. Steamboat people, and especially settlers, desire the removal of these obstructions.

I have to report that this part of the river and the North Fork as far as Cedar Creek are worthy of minor improvement, but that the work is not a public necessity.

No additional survey is required for preparation of an estimate and project. Work of improvement would consist in snagging operations and moderate scraping of bars, at an estimated annual cost of $1,000 for operating a steam snag-boat, when used on the Lewis.

A snag-boat is intended for the Lower Willamette and Columbia rivers and part service on the Cowlitz, where the Government has entered upon an improvement similar to that named for the Lewis River.

It could be used without disadvantage to those works for three to four weeks each year on the Lewis.

I quite agree with Captain Powell in the opinion that the Lewis River is worthy of improvement, and that no survey is necessary prior to operations for improvement.

The estimated cost of improvement is small compared with the advantages to be derived.

Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

T T 9.

PRELIMINARY EXAMINATION OF THE COLUMBIA RIVER, ABOVE THE MOUTH OF SNAKE RIVER, WASHINGTON TERRITORY.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., November 12, 1884.

SIR: I have the honor to make the following report of examination of Columbia River above mouth of Snake River, Washington Territory, in accordance with act of Congress, July 5, 1884, and your letter, July 31, 1884, to Capt. Charles F. Powell, Corps of Engineers, Portland, Oreg.

As sufficient examination of this portion of the Upper Columbia River has already been made, I refer to report of an examination of the Upper Columbia River by Lieut. Thomas W. Symons, Corps of Engineers, in September and October, 1881. [Senate Ex. Doc. No. 186, first session Forty-seventh Congress.] Also to annual report of Capt. Charles F. Powell, Corps of Engineers, 1883-'84. From Lieutenant Symons's report I collate the following:

NAVIGATION OF THE COLUMBIA RIVER.

From its mouth to the mouth of the Willamette the Columbia is navigated by ocean steamers, sea-going ships, and river craft of all kinds.

From the Willamette up to Cascades river boats find abundant water and go freely at all seasons of the year except when the river freezes up, which happens generally each winter. The freeze-ups on this portion of the river last but a short time, however.

At the Cascades the obstruction to navigation is complete. Boats cannot ascend the rapids at all, and they cannot descend with any degree of safety. Here, in order to render the river navigable, means must be adopted to pass boats both up and over the rapids. A canal with locks has been adopted as the means to do this, and work has progressed on it for several years. When this is completed navigation will be continuous up to the Dalles. This will throw the river open to all who wish to navigate it, and a healthy competition will be the result for all the trade centering on the river at and below the Dalles.

The Dalles is another complete and total obstruction to navigation. Boats can neither go up nor down them, and in consequence means must also be adopted here to pass them both up and down, if complete river navigation is proposed. Surveys have been made and plans and estimates are now being prepared for the desired improvement here.

With these two serious obstacles removed, there would be continuous navigation to Priest Rapids, a distance of 409 miles from the sea, and by the Snake River to the Grande Ronde River, 30 miles above Lewiston, a distance of 516 miles from the sea, making a total of navigable water of 589 miles. To this must be added the navigable waters of the Clearwater, the extent of which I do not know.

This would throw open to competition the river transportation demanded by the great grain belt between the Cascades and the Bitter Root Mountains, south of the 47th parallel.

By no other means could the Government confer a more decided and lasting benefit upon the people of this great section than by removing the obstructions to navigation at the Cascades and Dalles.

The portions of the river at present regularly navigated by river steamers are those below the Cascades to the mouth of the river; between the Cascades and the Dalles; and from Celilo, above the Dalles, to the mouth of Snake River, on the Columbia; and up the Snake to Lewiston. Once in a while a steamer makes a trip to Priest Rapids, but the business is not sufficient at present to cause one to be sent with any regularity. The Columbia, from the mouth of the Snake to Priest Rapids, is excellent for the purpose of navigation and will never need any improvement, in all probability.

If Priest Rapids could be improved it would give navigation thence to Cabinet Rapids, a few miles below Rock Island Rapids. The consequence of throwing this portion of the river into the prospective continuously navigable river below will be readily seen by a study of the map. The splendid valley of the Kittitas and Upper Yakima would have an easy and short outlet to the navigable river. I have never been in this portion of the country, but am assured by those who have that a great amount of fine land exists there.

On the other side of the river the fine country composing Badger Mountain would be benefited, and would be settled, and its produce taken to tide-water by the new boats.

The amount of country to the west of the river which would be benefited by the improvement of Priest Rapids is about 1,300 square miles, of which a large portion is arable and grazing land of excellent quality. On the east of the river there is an area of about 400 square miles, a great part of which is the finest quality of agricultural land. This, of course, is the area to be directly benefited; indirectly, all the country up the river would be benefited as well as all the portion below, which will need lumber and fuel, readily obtainable in the region of the Upper Yakima and Wenatchee.

CABINET AND ROCK ISLAND RAPIDS.

A distance of about 42 miles of navigable water lies between the head of Priest Rapids and the foot of Cabinet Rapids. This portion of the river, if it ever becomes well known, will be celebrated for its beauty and grandeur. Out of the same materials as those which compose the "Giant's Causeway" of Ireland nature has formed and decorated this locality.

In any scheme for the improvement of the navigation of the river Cabinet Rapids and Rock Island Rapids must be considered together, as they lie only about 4 miles apart.

Above Rock Island Rapids there is a stretch of 90 miles of navigable water to Foster Creek Rapids, 10 miles above the Okinakane. In this section of the river there are some portions where rocks are plenty and water swift and strong. They can, however, be avoided and overcome by a moderate amount of care, a sufficiency of power and skillful navigation.

There are four bars in this portion of the river, of which one, about 2 miles below the Okinakane, and another about 8 miles below Chelan, have undoubtedly a sufficiency of water for all purposes. The Wenatchee and Enti-at-qua bars are worse, and it will be well to determine accurately the depth of water on them at the lowest navigable stage, and build steamers to correspond thereto.

My observation did not extend over the entire water-course at either place, and I cannot tell positively the general depth that could be taken over. I believe, however, that on the Enti-at-qua Bar especially, a steamer drawing more than 3 feet would have serious difficulty in getting over at low water.

If it is deemed desirable to have steamers on the river drawing more water than there is on these bars, it will be easy and inexpensive to dredge out a channel of sufficient depth, and it might be that a simple improvement in the form of a wing-dam would cause the river itself to keep a channel of sufficient depth cut through. At all ordinary stages, however, there would be plenty of water for the class of boats likely to run on the river for many years to come.

We can therefore safely conclude that with Priest Rapids and Cabinet and Rock Island Rapids rendered navigable, the Columbia would be passable for river steamers to Foster Creek Rapids, a distance from its mouth of 559 miles. Let us consider what country would be benefited thereby.

First would be the Wenatchee country, which is splendid in quality and of considerable extent. The fine flat of about 25 square miles near the mouth is all that I can speak of with certainty, but undoubtedly up the river are other valleys suitable for agriculture, and a great amount of fine grazing land. The timber in the Wenatchee Mountains and in the whole region of timbered mountains west of the Columbia River will be valuable, and the whole interior country will be benefited by any plan which will assist in giving it easy and cheap transportation to those sections where it is needed.

Second. About the mouth of the Enti-at-qua the amount of arable land is not great: as to what may be in the interior I am unable to tell.

Third. About Lake Chelan there is a great deal of good agricultural land in the form of open prairies, bunch-grass-covered hills, and rich, rolling timbered country. The lake will furnish the means of getting at a large amount of valuable timber which exists along its banks.

Fourth. About the upper branches of the Methow there is a considerable extent of good agricultural and grazing land. The lower portion of the Methow flows through a range of wooded hills and is hemmed in closely by them; further up, these hills become more rolling and grassy, and the banks of the streams are bordered by level and wide terraces of excellent soil. Throughout this large territory of 4,675 square miles, now set apart for Chief Moses and his people, there are many fine valleys and agricultural hills which would be benefited by an open river.

Fifth. The magnificent country bordering upon and tributary to the Okinakane would be immensely benefited by an open, through river navigation. I have already described, as far as I could, the country in the vicinity of the Okinakane, and will not do so again here.

Sixth. All that portion of the Great Plain of the Columbia lying between the river and the Grand Couleé and Badger Mountains would be benefited by the improvement. This region is at present unsettled and far away from market, but it is a fine agricultural section and will have a large population some day.

The amount of country which would receive a direct benefit from the improvement of Rock Island and Cabinet rapids, assuring, of course, the removal of all obstructions, and a free and open river below, would be about as follows, the areas given being, as near as possible, the agricultural and choice grazing lands:

	Square miles.
Vicinity of Wenatchee and Enti-at-qua	120
Vicinity of Lake Chelan	100
Vicinity of Methow	
Vicinity of Okinakane	
Great Plain, west of Grand and Moses coulées	
Total	2,820

The indirect benefits to the whole country east of the mountains would be very great, as it would insure the easy and cheap transportation to the grain belts about Walla Walla and the Lower Snake and Columbia of the wood and lumber abounding about Lake Chelan, the Wenatchee, Methow, Okinakane, and other streams. This commerce in lumber will certainly be of great importance. Besides the commercial interests involved in the raising and shipment of grain, cattle, wool, lumber, &c., other interests of great importance are apt to be created as the country is examined, if mines of the precious metals, iron, coal, &c., are discovered and developed.

I come next to consider the benefits which would arise if the river from Foster Creek Rapids to the Mahkin Rapids was improved so as to allow boats to pass freely from the good river below to the good river above, and vice versa. In order to consider this properly, it is necessary to go ahead a little and take a look at Hell Gate and the Spokane Rapids, the only other obstructions worthy of mention below Grand Rapids, near the mouth of the Colville River.

Until proved to the contrary, I shall consider that Hell Gate is navigable both up and down for steamers. If it is proved to be too swift for boats to ascend, then some method must be adopted for its improvement, which can be considered further on.

Acknowledging that Hell Gate is navigable, we come to the Spokane Rapids, which are not navigable except by a steamer using a line. They are short, and the waters have a considerable fall; but, as I have previously said, they can be rendered passable at a small expense by removing the bowlders and rocks which clog the channel and are the cause of the rapids. An expenditure of $20,000 would, I believe, effectually improve this bad place and render it easily navigable at all stages of water. In the mean time, until their improvement shall be completed, any boats engaged in commerce on the river can line over the rapid safely, as the channel has plenty of depth, and is straight.

This portion of the river, then, from Mahkin to Grand Rapids, a distance of 122 miles, must be considered as navigable, since the only obstructions in it are of such a temporary nature.

If, then, we assume that the river from Foster Creek Rapids to Mahkin Rapids be improved to allow the passage of boats, we see that it will open up the river to Grand Rapids, and all the country tributary to the river up to this point will be directly benefited by the improvement. About a good deal of this country very little is known, but judging from what I do know and have been told, and from the general appearance of the country as seen from a distance, I think that a fair estimate of the good productive land (arable and grazing) which by means of the river improvement would be brought into direct river communication with tide-water is as follows:

	Square miles.
Vicinity of Nespilem River	360
Vicinity of Sans Poil River	540
Immediate vicinity of Columbia River	1,020
Vicinity of Colville River	600
Vicinity of Spokane River	200
Great Plain south of Spokane and Columbia	2,400
Total	5,120

It is scarcely worth while for me to enlarge on the general benefit to the whole North Columbian Basin which would be conferred by removing all the obstructions and giving through river navigation from Grand Rapids to the sea.

The continued, earnest, and united efforts of other countries and sections to obtain water transportation to the seaboard by means of rivers and canals sufficiently attest the estimation in which it is held by the people, and its value and importance is clearly shown by all the navigable rivers and internal water routes of the world.

The Government of the United States has commenced the improvement of the Columbia at the first obstruction, the Cascades; it has taken the preliminary steps toward the improvement at the Dalles, and it will ere long be called upon to commence the improvement at Priest Rapids and the upper rapids to give a continuously navigable river.

If we take a glance forward to the time when all this eastern portion of Washington Territory shall be settled, when the whole land shall be a waving field of grain with here and there a village or a city; with railroads traversing the country in every direction, and a vast commerce being carried on between the sea and the interior; if we picture to ourselves all this with the Columbia in its present state of interrupted navigability, and then picture it with the river completely navigable from the Grand Rapids to its mouth, we shall be able in some degree to appreciate the importance of undertaking and completing the great works of improvement needed on the river.

In considering the amelioration of the river from the Grand Rapids to its mouth we can divide the rapids which form obstructions to navigation into two classes: first, those which do not admit the passage of steamers either in ascending or descending the river, and cannot be made to admit this passage by any work upon the rapids themselves; and, second, those which, while forbidding the passage of steamers in ascending, permit them to descend in safety or can be made to permit the downward passage by work on the rapids themselves.

The Dalles, the Cascades, Grand Rapids, and Kettle Falls belong to the first class; all the other bad rapids belong to the second class.

Priest, Cabinet, Rock Island, and the Nespilem rapids all permit or can readily be made to permit the downward passage of steamers. If, then, we suppose that a loaded steamer engaged in river commerce can start at Grand Rapids and safely descend the river to the Dalles, and by means of improvements here and at the Cascades to the river's mouth, the problem simplifies itself into adopting some system of improvement to permit this steamer with its load to ascend the river.

Passing up from the Cascades and Dalles, the first obstacle which presents itself is Priest Rapids.

From Captain Powell's report I quote:

> There is a fast-growing demand for river transportation above Priest Rapids as high as the Okinakane Valley. These rapids offer a serious obstacle to continuous navigation, but it is believed from reliable information that this obstruction, and certainly the higher reaches together of 150 miles and as far as Foster Creek Rapids are susceptible of open river improvement.

On the Columbia, between the Snake and Priest Rapids, there does not appear, from examinations and reports of pilots, to be any need of improvements, but I judge it will be well to allow $100 per mile for removal of obstructions which may appear at extreme low stage.

Above Priest Rapids, except at Cabinet and Rock Island, where the channels are bad, the river is like the original condition of the route from Celilo to Lewiston, which improvement is costing about $500 per mile. Applying this rate to the Foster Creek reach, and omitting the principal rapids named above, we have $67,500. Comparing these rapids to the minor Cascades, where rock work is in progress, as of equal difficulty but double extent, cost of required improvement of the former may be judged to be $400,000, or in the neighborhood of $480,000 for the Foster Creek and Grande Ronde reaches. While this amount could not be judiciously expended in one year because the working season is too short, more advantageous contracts for the work could be made under a total appropriation available in annual installments than under a partial amount. This proposed extended improvement, like that now in progress, is rock removal from channels between stable banks where navigation is impeded by bowlders, reefs, and rock masses.

Beyond Foster Creek there are 400 miles of navigable water on the main river, reaching north of the Canadian Pacific Railroad, and nearly half as much on the Kootenay, broken by two places, where canals or portages are required.

COMMERCIAL STATISTICS.

These rivers are in the collection district of Willamette. Portland, Oreg., is the nearest port of entry. The nearest light-houses and works of defense are at the mouth of the Columbia River.

There are several garrisons of troops in the immediate region. The revenue collected at Portland for the thirteen months ending June 30, 1884, was $402,290.76.

The productions of the Upper Columbia country are rapidly increasing. The natural outlet for shipment is on the line of the Columbia River, by water or rail. The complete barriers at the Dalles and at the Cascades, where portages for through traffic were formerly used, prevent navigation to the seaboard from being continuous. The river boats are used as feeders for the through-rail routes; one line runs from Lewiston, at the mouth of the Clearwater, to Riparia, on the Snake; a second line from below Riparia to Ainsworth, at the mouth of the Snake; and a third from Priest Rapids to Ainsworth, and thence to Celilo, for accommodation of traffic on side of river opposite the railroad. Riparia, Ainsworth, and Celilo are points in the railroad system.

There is sufficient traffic from regions which the railroads cannot reach, and which the rivers do, to warrant the completion of the present project of improvement.

The Government has entered on a canal work at the Cascades, now well advanced. An estimate and project for improving the Dalles were submitted in 1882; the cost of the first stage of construction is $283,353.61, which stage would be required in any plan of improvement—canal, open river, or boat-railway. The completion of the Cascades and Dalles works will make local improvements on the upper rivers more valuable. These waters will probably in the near future be parts of a through transportation route from Idaho, Eastern Oregon, and Washington to the head of ship navigation.

Opening the Foster Creek reach will give an outlet to nearly 3,000 square miles of productive valley and plain now shut off from transportation. The next extension will drain southwards a rich country, mostly in British Columbia, all of which otherwise would depend on the Canadian Pacific Railroad.

Principal receipts at Portland from the Upper Columbia country for the twelve months ending June 30, 1884.

[Furnished by the Portland Merchants' Exchange.]

Articles.	Quantity.	Value.
Wheat .... centals..	2, 057, 746	$3, 174, 830
Flour .... barrels..	175, 477	769, 302
Barley .... centals..	120	90
Bran .... pounds..	765, 640	6, 740
Mill-stuff (unspecified) .... do ..	1, 076, 926	16, 085
Potatoes .... sacks..	1, 750	1, 940
Hay .... bales..	916	2, 710
Wool .... pounds..	7, 539, 801	1, 116, 665
Hides .... do....	939, 309	84, 550
Butter .... packages..	89	1, 541
Eggs .... do....	111	1, 595
Fruit .... do....	1, 561	1, 242
Flaxseed .... sacks..	33, 222	96, 075
Hops .... pounds..	78, 740	12, 975
Cattle .... number..	7, 175	287, 000
Horses .... do....	436	41, 680
Sheep .... do....	18, 268	46, 486
Mules .... do....	38	8, 800
Hogs .... do....	700	4, 559
Total value	....	5, 669, 865

Receipts previous year were valued at $3,985,478.

Statement of imports to, and exports from, Snake River points, by steamboat, for ing June 30, 1884.

[Furnished by Auditor Oregon Railroad and Navigation Company.]

IMPORTS.

Articles.	Where to.
Merchandise	Riparia and above

EXPORTS.

Articles.	Where from.			
	Ainsworth to Almota.	Almota.	Almota to Lewiston.	Lewiston.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Merchandise	46	114	42	108
Flour and feed	1,359	396	477	
Household goods				4
Cattle	3	5	1	2
Hides	32	5½	2	6½
Wool	428	105	13	24
Wheat	5,903	2,647	9,311	2,713
Flaxseed		10	1,157	349
Other grains		2		
Potatoes		1	2	
Miscellaneous		13	12	46
Total	7,817	3,118½	11,017	3,269½

STATEMENT BY FRANK T. DODGE, SUPERINTENDENT RIVER DIVISION OF OREGON ROAD AND NAVIGATION COMPANY, OF THE RIVER FLEET AND ITS ROUTES.

PORTLAND, OREG., *July* 15, 18

DEAR SIR: The following is a list of our boats on the Upper Columbia and rivers, and their carrying capacities. They can navigate those rivers anywhere tween Celilo and Priest Rapids and the mouth of the Grande Ronde during stages of water, but they are principally engaged in carrying grain, &c., from iston and points below to Riparia, where one branch of the railroad terminates. also carry wheat from points on Snake River, about 35 miles above Ainsworth, railroad at the latter place.

Name.	Capac
D. S. Baker	[illegible]
Annie Faxon	[illegible]
Almota	[illegible]
John Gates	[illegible]
Spokane	[illegible]
Northwest	[illegible]

Yours, truly,

FRANK T. DODGE,
Superintendent.

Capt. CHAS. F. POWELL.

From the exhaustive and finished presentation of the subject by Captain Powell and Lieutenant Symons, I conclude that the Columbia River above the mouth of Snake River is worthy of improvement, but I would recommend that the necessary operations be preceded by such a survey as will enable me to deduce plans of improvement from a general study of the whole situation. I estimate that such a survey as far up as, and including the Priest Rapids obstruction, will cost $12,500.

Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1884.

SIR: The estimates received at this office for the surveys required under the river and harbor act of July 5, 1884, being in excess of the funds available for that purpose, it has become necessary to make a reduction in all estimates submitted.

You will please, therefore, revise your estimate for the survey of the Columbia River, between the mouth of the Snake and Priest Rapids, submitted with your report of November 12, reducing it to the least amount required for a survey with a view to the improvement of the 12 miles of the river at Priest Rapids, and limiting yourself to such an examination of the river between the foot of those rapids and the mouth of the Snake as will enable you to submit an estimate of the cost of clearing the few obstructions that are said to exist in that stretch of the river.

An early reply is desired.

By command of Brigadier-General Newton.

Very respectfully, your obedient servant,

JOHN G. PARKE,
Colonel of Engineers,
Bvt. Maj. Gen., U. S. A.

Maj. W. A. JONES,
Corps of Engineers.

REPORT OF MAJOR W. A. JONES, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Oreg., December 19, 1884.

SIR: I have the honor to acknowledge receipt of Department letter of 1st instant, requesting a revision of my estimate for the survey of the Upper Columbia River, confining operations to the 12 miles at Priest Rapids, and making minor examination of the river below as far as the mouth of Snake River.

My estimate was based upon the cost of surveying the reach at The Dalles. It seems to me that the question of improving the Columbia River is so important, the river of such volume and extent, that it will be well to go a little slow in presenting projects for improvement and have them based on considerably more knowledge than we now possess. Such knowledge can only be obtained by thorough surveys. I shall at a proper occasion present a project for making a complete survey as far as the boundary line, with the establishment of gauges at a number of points, so that we may get some idea of the probable effects of our operations.

At the same time there is a strong demand for immediate relief from the country above Priest, Cabinet, and Rock Island rapids, which might be met by clearing out rocks in the reaches between them, leaving portages at those points. Perhaps some means of pulling boats up the rapids by lines may be devised.

I will therefore modify my estimate so that it will enable a rapid survey to precede operations under Captain Powell's project, as set forth in his annual report for this (current) year.

For this purpose I estimate that the sum of $6,000 will be required.

Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

T T 10.

SURVEY OF COLUMBIA AND SNAKE RIVERS.

The time has arrived when further progress in the improvement of the Upper Columbia and Snake rivers must be preceded by a careful survey. The Columbia has now been surveyed as far up from the sea as the mouth of the Willamette, at the Cascades, and at the Dalles; and the survey of Priest Rapids will soon be completed. It is perfectly obvious that any further projects can only be intelligently guided by a good survey. I cannot too strongly urge the necessity for this survey. These are rivers of commanding importance, and it is quite time that they should be studied by the light of careful surveys, such as are now in progress upon the Mississippi and Missouri rivers. The distances to be surveyed are about 630 miles on the Columbia and 137 miles on the Snake, as far as Lewiston, making a total of 767 miles. At $150 per mile, the cost would be, in round numbers, $115,000.

This can be advantageously expended in two annual installments of $40,000 and one of $35,000.

I have, therefore, to recommend that there be appropriated for the year ending June 30, 1887, the sum of $40,000, for the survey of Columbia and Snake rivers.

APPENDIX U U.

MAINTENANCE AND REPAIRS OF WASHINGTON AQUEDUCT—INCREASING WATER SUPPLY OF THE CITY OF WASHINGTON—ERECTION OF FISH-WAYS AT THE GREAT FALLS OF THE POTOMAC.

REPORT OF MAJOR G. J. LYDECKER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Washington Aqueduct.
2. Increasing the water supply of the city of Washington.
3. Erection of fish-ways at the Great Falls of the Potomac River.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., August 12, 1885.

GENERAL: I have the honor to transmit herewith reports of operations on the Washington Aqueduct; increasing the water supply of Washington, D. C.; and erection of fish-ways at Great Falls of the Potomac, for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

G. J. LYDECKER,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

U U 1.

WASHINGTON AQUEDUCT.

During the summer and fall of 1884 the work of macadamizing the Aqueduct road, which has been in progress for several years past, was extended to the point at which it diverges from the line of the conduit, about 2½ miles by the road from the site of the dam, and inlet to the aqueduct, at the Great Falls. Some stone was also placed on the worst parts of the road beyond that point over distances aggregating about 1,500 feet.

The total expenditure of broken stone for the above work and for scattering repairs on parts of the road previously improved was about 2,000 cubic yards.

At the end of August the water-level at the Great Falls Dam was 5 inches below its crest. Repairs were made to the temporary brush and stone dams at the head of Conn's Island, by which a larger flow into the Maryland Channel was induced, and the water-level raised to an elevation of 1 inch above the dam.

The water-level during the year varied between a maximum of 2.3 feet above the crest of the dam to a minimum of 0.4 foot below it, the total fluctuation being only 2.73 feet.

In December a wire screen 15 feet long and 6 feet deep was placed across the inlet to the aqueduct at the falls, to prevent the inflow of drift and other floating matter.

In the spring of 1885 an overflow weir was constructed at the receiving reservoir to carry off storm waters. It is of masonry, 76 feet long, with its crest at an elevation of 146.5 feet above high tide. The effluent gate at this reservoir was also thoroughly repacked.

The work above outlined comprises the principal operations of the year, beyond the usual routine involved in the care of the aqueduct and distribution of the water supply.

The report of Capt. T. W. Symons, Corps of Engineers, United States Army, which is transmitted herewith, describes somewhat more in detail the operations of the year, and supplies certain statistics of interest, from which the following items are taken, as indicating the amount and character of water supplied.

The outflow from the distributing reservoir during the twenty-four hours commencing at 6 a. m. on the 26th of June, 1885, was 25,219,19 gallons. This is the amount drawn off by the mains during that period, and shows the amount so taken as averaging about 140 gallons per capita of the population of Washington and Georgetown. The corresponding amount last year was 24,827,013 gallons.

The average of mean monthly pressures in the supply-mains at crossing of Rock Creek was 31.72 pounds per square inch. The time corresponding to this average pressure is 9 a. m., at which time the flow through the mains is ordinarily a maximum. The pressure last year was 32.13 pounds, and the year before only 30.87 pounds.

At the effluent gate of the distributing reservoir the water was clear during 211 days, slightly turbid 20, turbid 53, and very turbid 81, differing in this respect but slightly from its general condition during the preceding year.

The total amount appropriated on account of the Washington Aqueduct from September 30, 1850, to June 30, 1885, is $3,925,157, of which $80,000 has been from the revenues of the District of Columbia. Of the total amount appropriated, $3,455.38 has reverted to the United States Treasury, leaving $3,841,701.62 for the net cost to the United States for the aqueduct and its maintenance from 1850 to June 30, 1885. Since 1878 one-half of the amounts appropriated have been contributed by the United States and the other half by the District of Columbia.

The following is a money statement for the fiscal year ending June 30, 1885:

Amount appropriated by act of July 5, 1884		$20,000 00
Amount appropriated by act of February 25, 1885		20,000 00
		40,000 00
Amount expended during the year	$18,610 77	
Outstanding liabilities June 30, 1885	1,389 23	
		20,000 00
Amount available June 30, 1885		20,000 00
The amount required for the fiscal year ending June 30, 1877, is		20,000 00

The amount named above as required for the next fiscal year is that which long experience has shown to be necessary for the annual maintenance and repairs of the aqueduct and its accessory structures.

The organic act establishing the present form of government for the District of Columbia provides that the sum necessary for this purpose hall be included in the annual estimates submitted to Congress by the District Commissioners, and one-half of the amount annually appropriated on that account is taken from the revenues of the District for the corresponding year. As one of the Commissioners, I am advised of the fact that the revenues of the District cannot now contribute annually n this direction a sum materially in excess of the customary appropriation; nor does the organic act to which I have referred appear to contemplate that the Commissioners should go further and submit as a part of their estimates for the support of the District government in any one fiscal year an estimate for additional works, or any considerable modifications of existing structures, such as might be deemed necessary for eliminating all danger of pollution to the water supply in the future.

Congress has intrusted to the War Department the care and management of this work, and it is therefore proper that the duty and responsibility of presenting any project for its perfection should devolve upon that department. For this reason I have caused to be prepared a project which has for its objects the elimination of all danger of pollution to the supply of Potomac water, and its delivery in the *greatest possible purity.*

During the past spring the keenest apprehensions were excited in the minds of a large portion of this community by a series of most alarming and exaggerated representations, to the effect that the supply was unutterably polluted at the inlet to the aqueduct and at the receiving reservoir.

In relation to these representations I only desire to say here that the condition of affairs at these points last spring was substantially the same as it had always been since the aqueduct was completed, and that the water supplied to the city at that time was as pure as it ever has been. Some of the surroundings were unsightly and suggestive of possible contamination to the water supply in the future, but not such as to warrant any feelings of alarm at the time. This view was fully confirmed by the results of several analyses, made independently by three disinterested and expert chemists.

Under the heading of "Improving the condition of the water-supply," in the report transmitted herewith, Captain Symons presents the subject in such detail that I shall limit myself to a brief reference to its several important features.

At the Great Falls the only possible chance of pollution that might arise is from the canal level, which extends from the dam to a point about 2 miles above, becoming exceedingly foul and discharging its waters freely into the river near the inlet into the aqueduct. To guard against this the waste-weirs above the dam have been closed, and a new discharging-weir has been constructed below the dam, so that when the canal-level is emptied all its contents will pass into the Potomac below the dam. This work was authorized by the Secretary of War, on the suggestions made in my letter dated May 23, 1885, for the purpose of allaying the alarm of the public that had been excited by the representations referred to above. With the same object in view the river bank between the canal and Maryland Channel, near the inlet to the aqueduct, has been cleaned up.

This strip of land up to a point opposite the head of Conn's Island, a distance of about 2,869 feet, and comprising about 12 acres, is claimed as the property of the Chesapeake and Ohio Canal, and it is desirable that it should come into the possession of the United States, so that its occupation may be controlled in such manner that the purity of supply shall not be threatened. Surface drainage over this land is directly the quiet waters of the Maryland Channel, which constitutes the di line of supply to the aqueduct, whereas above that limit the drain is into the full channel of the Potomac, where full flow and rapid c rent would neutralize all elements of contamination that might reac from that section. It is represented that the canal company is debar by its charter from making sale of this strip of land referred to ab and I would therefore recommend that Congress be asked to autho its condemnation as a necessary measure to maintaining the purity water supplied to the District by the Washington Aqueduct. It is lieved that the value of the land does not exceed $600, and that the penses for surveys, appraisement, examination of title, and fencing lands will be about $400 more, or $1,000 in all.

This would accomplish all that now appears to be necessary to aff security against pollution before the water enters the aqueduct.

The next and only other source of danger to the purity of supply found at the receiving reservoir, which is so located as to receive drainage of over 4,000 acres. The streams by which this area is drain into the reservoir have already carried to and deposited in it a consid able amount of sediment and foreign substances, so that a considera portion has become a marsh and filled with vegetable growth. Besid after heavy rains, these streams bring in large volumes of turbid wat

For these reasons they should be directed in such manner that th will be discharged into natural channels beyond the limits of the rese voir. The way in which it is proposed to accomplish this is detailed Captain Symons's report and accompanying tracings.

To preserve the purity of supply it is also important that certain trac of land on the side hills and adjoining the reservoir, as shown on ma transmitted herewith, and aggregating about 17 acres, should come i the possession of the United States; and, finally, the shallow portio of the reservoir contiguous to the shore line should be dredged t depth to give security against the growth of water-plants, and the s slopes should be paved or revetted with riprap.

The estimates submitted by Captain Symons indicate that the co of the work outlined above would be $130,000, of which amount the su of not less than $100,000 is required for the most vital and pressing pu pose of diverting the tributary streams.

The appropriation of the amount above indicated, $130,000, will affor the means of securing all that is necessary for providing in the mo certain manner against all danger of pollution to the water supply, an it is insignificant in comparison with the results that will be acco plished by its expenditure.

REPORT OF CAPTAIN THOMAS W. SYMONS, CORPS OF ENGINEERS.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., July 30, 1885.

SIR: I have the honor to submit the following annual report of operations for the fiscal year ending June 30, 1885, on the Washington Aqueduct, * * * of which by your order, I am superintending engineer.

WASHINGTON AQUEDUCT.

The operations on the Aqueduct have been throughout the year of the customary routine nature required for the proper maintenance and distribution of the water supply, and the care and preservation of the Aqueduct and its accessory structures.

Incidental repairs have been made, as found necessary, to the several bridges, culverts, fences, telegraph line, aqueduct roadway, keepers' dwellings, offices, and other buildings.

At Great Falls the grading and macadamizing the road above Bridge No. 3 was ommenced in August, and was finished during the month of October.

Arrangements were made with the farmers to furnish flint rock at convenient places along the line of the road at $1 per cubic yard, which is considered to be a very advantageous arrangement for getting stone for repairs.

A 12-inch by 18-inch culvert, 20 feet long, was made across the road near Tunnel F.

On August 28 and 29, 1884, the temporary dam at the head of Conn's Island was repaired, as the water stood 5 inches below the masonry dam. The result was to raise he water 6 inches, and to help the city's supply materially; 1,479 linear feet of macadam-road was made between the junction and the Falls.

In December a screen 15 feet long by 6 feet deep was purchased, and a frame was made for it and it was placed over the mouth of the feeder to prevent trash, leaves, brush, &c., from floating in.

During April, 1885, the effluent gate at the receiving reservoir was supplied with a new gum packing throughout.

During April and May, 1885, an overflow weir was constructed at the receiving reservoir, to enable storm-waters to run off over the connecting conduit and down the channel originally excavated for this purpose. This is 75 feet long and 27½ feet wide, with side walls 2¼ feet thick and 3 feet above the overflow line. The reference of the op of the weir is 146.5 feet above high tide. It is constructed of stone set in cement mortar on a foundation of 12 inches of concrete. The rock used for the work was hauled from Foundry Branch Shaft.

In May, 1885, a stone-crusher was purchased and set up at Foundry Branch Shaft, and an engine and boiler hired, and about 400 cubic yards of stone broken, when furher work was stopped.

During August, 1884, a leak developed in the high-service reservoir. The water was kept down to 218 feet for some time, when the leak nearly disappeared and the usual height of water was restored.

The Rock Creek Bridge, Foundry Branch pipes, and the iron work about the high-service reservoir were all painted in the spring of 1885.

About 2,000 cubic yards of stone were broken and expended in repairing the roads during the year. About 300 yards of stone are now on hand along the line of the oad.

On the morning of the 26th of June the supply of water was shut off from the distributing reservoir for twenty-four consecutive hours, to determine the quantity of water consumed in the city of Washington.

At the commencement the water stood in the reservoir at a height of 145.25 feet above reference, and at the end it was 143.44 feet—a fall during 24 hours of 1.81 feet.

The following table gives the fall of the water in the reservoir in decimals of a foot and the number of gallons consumed each hour:

Date.	Fall.	Consumption per hour.
June 26.		
	Feet.	*Gallons.*
From 6 a. m. to 7 a. m	.07	982,633
From 7 a. m. to 8 a. m	.08	1,122,288
From 8 a. m. to 9 a. m	.09	1,261,612
From 9 a. m. to 10 a. m	.10	1,400,794
From 10 a. m. to 11 a. m	.06	839,891
From 11 a. m. to 12 m	.09	1,259,031
From 12 m. to 1 p. m	.07	978,564
From 1 p. m. to 2 p. m	.09	1,257,281
From 2 p. m. to 3 p. m	.09	1,256,301
From 3 p. m. to 4 p. m	.07	976,439
From 4 p. m. to 5 p. m	.08	1,115,211
From 5 p. m. to 6 p. m	.07	975,168
From 6 p. m. to 7 p. m	.08	1,113,759
From 7 p. m. to 8 p. m	.08	1,112,975
From 8 p. m. to 9 p. m	.08	1,112,203
From 9 p. m. to 10 p. m	.06	833,644
From 10 p. m. to 11 p. m	.07	972,034
From 11 p. m. to 12 m	.07	971,435
From 12 m. to 1 a. m	.06	832,193
June 27.		
From 1 a. m. to 2 a. m	.08	1,108,905
From 2 a. m. to 3 a. m	.06	831,175
From 3 a. m. to 4 a. m	.06	830,734
From 4 a. m. to 5 a. m	.07	968,637
From 5 a. m. to 6 a. m	.08	1,106,287
Total	1.81	25,219,194

For the past twelve years the average daily outflow of water from the distributing reservoir, measured the latter part of June, has been as follows:

Year.	Gallons.	Year.	Gallons.
1874	15,554,848	1880	25,744,[illegible]
1875	21,000,000	1881	26,525,[illegible]
1876	24,177,797	1882	29,7[illegible]
1877	23,252,932	1883	24,314,[illegible]
1878	24,885,945	1884	24,8[illegible]
1879	25,947,642	1885	25,219,[illegible]

I give herewith, compiled from the records of the office, a table showing for each day of the fiscal year just passed the condition of the water at the Great Falls, at the south connection or effluent of the receiving reservoir, and the effluent of the distributing reservoir. In determining the condition of the water a metallic tube 36 inches long, with glass ends, is used. This is filled with water and the distance at which a ball immersed in the water can be seen from the glass end is noted; when it can be seen the whole length of the tube the water is considered clear, and the reading grows less and less as the water becomes more and more turbid, decreasing down sometimes so that it can only be seen at a distance of half an inch.

This table also gives the pressure of the gauge at Rock Creek office every day at 9 a. m. It also gives the height of water over dam at the Great Falls, for each day of the year, in feet:

Day of month.	July, 1884.					August, 1884.					September, 1884.					October, 1884.				
	Condition of water.					Condition of water.					Condition of water.					Condition of water.				
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.	Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.	Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.	Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.	Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.
				Feet.					*Feet.*					*Feet.*					*Feet.*	
1	3	4	7	1.08	32	2	7	36	1.33	33	26	36	36	.12	34	36	36	36	–.23	31
2	5	8	8	.83	32	2	13	36	1.08	33	36	36	36	.08	34	36	36	36	–.21	31
3	5	5	6	.67	32	3	18	36	.50	32	36	36	36	.08	34	36	36	36	–.12	31
4	9	8	6	.67	32	4	18	36	.42	33	36	36	36	.06	34	36	36	36	–.10	31
5	12	13	8	.67	32	5	15	36	.42	33	36	36	36	.06	33	36	36	36	–.08	32
6	12	21	8	1.17	32	2	20	24	.50	32	36	36	36	.04	33	36	36	36	–.12	31
7	8	22	8	1.00	32	2	21	34	.33	33	36	36	36	.04	33	36	36	36	–.12	31
8	2	33	9	.67	32	2	19	23	.17	33	36	36	36	.04	30	36	36	36	–.14	30
9	2	32	10	.50	32	5	15	31	.12	33	36	36	36	.02	30	36	36	36	–.17	30
10	2	21	12	.33	32	5	7	31	.08	33	36	33	36	.02	30	36	36	36	–.21	30
11	3	13	15	.33	32	8	5	30	.04	33	36	36	36	–.02	30	36	36	36	–.21	30
12	1	7	15	.25	32	10	10	28	.04	33	36	36	36	–.02	30	36	36	36	.21	31
13	3	8	18	.17	32	14	15	14	.08	33	36	36	36	–.02	30	36	36	36	–.21	31
14	8	6	13	.17	32	16	18	29	.08	33	36	36	36	–.04	32	36	36	36	–.21	30
15	10	6	13	.17	32	26	22	22	.04	33	36	36	36	–.04	31	36	36	36	–.21	31
16	10	8	14	.17	32	34	31	36	.04	32	36	36	36	–.04	31	36	36	36	–.21	31
17	12	12	16	.12	32	36	36	36	.02	32	36	36	36	–.06	31	36	36	36	–.21	31
18	16	16	19	.08	32	36	36	36	.02	32	36	36	26	–.08	31	36	36	36	–.21	31
19	32	21	21	.04	32	36	36	36	–.04	32	36	36	36	–.12	31	36	36	36	–.25	32
20	36	30	33	.04	33	36	36	36	–.12	32	36	36	36	–.14	31	36	36	36	–.29	31
21	36	33	30	.04	32	36	36	36	–.21	32	36	36	36	–.17	31	36	36	36	–.29	30
22	36	34	34	.02	33	36	36	36	–.21	32	36	36	36	–.19	31	36	36	36	–.25	31
23	36	36	36	.02	33	22	36	36	–.25	32	36	36	36	–.21	30	36	36	36	–.25	31
24	36	36	36	–.02	32	23	36	36	–.33	33	36	36	36	–.23	30	36	36	36	–.25	31
25	36	36	36	–.02	32	25	36	36	–.29	32	36	36	36	–.23	31	36	36	36	–.31	31
26	1	36	36	–.06	32	36	36	36	–.33	32	36	36	36	–.23	30	36	36	36	–.31	32
27	1	36	36	.08	32	36	36	36	–.35	32	36	36	36	–.23	30	36	36	36	–.31	31
28	2	24	36	.08	32	36	36	36	–.39	32	36	36	36	–.23	32	36	36	36	–.33	32
29	2	18	36	.25	32	36	36	36	–.42	33	36	36	36	–.23	31	36	36	36	–.31	32
30	4	15	36	.58	33	36	36	36	–.42	32	36	36	36	–.23	31	36	36	36	–.21	32
31	2	10	36	1.33	32	36	36	36	.08	33	......	......	......	......	......	36	36	36	–.12	32

Day of month.	November, 1884.					December, 1884.					January, 1885.					February, 1885.				
	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.			Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.			Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.			Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.		
				Feet.					*Feet.*					*Feet.*					*Feet.*	
1	36	36	36	—.08	32	4	3	4	.25	32	3	30	25	1.17	32	32	36	10	.83	31
2	36	36	36	—.04	32	4	4	5	.19	31.5	2	5	24	1.25	32	33	36	11	.92	31
3	36	36	36	.04	32	6	5	6	.17	32	2	15	27	1.00	29.5	35	36	11	.92	31
4	36	36	36	.08	32	7	7	6	.17	32	3	12	22	1.17	30	32	36	12	.83	31
5	36	36	36	.21	32	8	3	6	.17	32	3	10	29	1.08	30	34	36	12	.92	31
6	36	36	36	.12	32	12	7	6	.12	32	5	8	29	1.08	32	8	36	14	.92	32
7	36	36	36	.08	32	1	8	6	1.00	32.5	2	7	31	1.33	31	6	36	18	.75	31
8	36	36	36	.08	32	1	5	6	1.42	31	3	7	17	1.50	31	8	36	22	.75	31.5
9	36	36	36	.04	32	2	6	6	.92	31.5	3	6	15	1.50	32	8	24	26	.75	31
10	36	36	36	.04	32	3	4	8	.83	32	3	6	11	1.58	33	1	17	28	1.25	32
11	36	36	36	.02	32	3	3	7	.71	32	3	4	8	1.42	31.5	3	13	21	.83	31
12	36	36	36	.02	32	5	4	6	.67	32	5	4	6	1.33	33	4	8	16	.67	31
13	36	36	36	—.02	32	3	4	6	.58	32	5	3	5	1.58	32	8	6	10	.58	31.5
14	36	36	36	—.02	32	5	5	5	.67	33	4	4	5	1.58	32	9	5	7	.58	32
15	36	36	36	.02	31.5	2	5	4	.87	32.5	4	4	4	1.42	33	10	7	5	.67	31.5
16	36	36	36	—.02	32.5	3	5	4	1.33	32	3	3	4	1.58	33	8	10	4	.75	32
17	36	36	36	—.04	32.5	1	4	4	1.42	32	5	4	4	1.75	33	7	15	3.5	.67	31
18	36	36	36	—.02	31	2	5	4	1.25	32	1	4	4	2.33	30.5	8	9	3	.58	31.5
19	36	36	36	—.02	31	4	6	5	1.00	(*)	2	7	5	2.00	31	9	9	3	.50	31.5
20	36	36	36	.04	31	5	4	5	.50	(*)	3	5	5	1.58	32	15	11	4	.42	31
21	36	36	36	.04	31.5	7	9	6	.25	(*)	3	6	6	1.42	32	18	14	4	.42	31
22	36	36	36	—.04	32	7	10	6	.17	28.5	4	6	6	1.17	31	17	17	4	.42	31
23	36	36	36	—.06	32	10	14	6	.25	29	7	6	6	.92	30	18	19	5	.37	30
24	6	36	26	.67	31.5	12	16	6	.42	29	8	8	6	.92	31	18	21	7	.37	30
25	3	10	36	.79	31.5	14	18	8	.33	29.5	12	15	6	1.00	31	21	29	7.5	.50	30.5
26	3	6	33	.50	31.5	10	18	8.5	.75	30	16	19	7	1.00	31	24	29	8	.58	31
27	3	4	30	.42	32.5	7	18	10.5	.92	30	22	20	7	.92	31	31	36	9	.67	31
28	3	4	27	.29	32	8	20	15	.83	29	29	20	8	.75	31.5	28	30	11	.58	31
29	5	4	12	.33	31.5	8	28	18	.83	31.5	28	22	8	.60	31	......	......	......	......	......
30	5	4	7	.25	32.5	11	36	24	.75	32	33	27	8	.45	31	......	......	......	......	......
31	......	......	......	......	..	8	30	26	.83	32	33	28	9	.67	31	..	..	..	.	..

* Gauge [illegible].

Day of month.	March, 1885.					April, 1885.					May, 1885.					June, 1885.				
	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.	Condition of water.			Height of water over dam at Great Falls.	Gauge pressure at Rock Creek, pounds per square inch.
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.			Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.			Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.			Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gate-house.		
				Feet.					*Feet.*					*Feet.*					*Feet.*	
1	8	36	13	.67	32½	4	20	11	1.42	32	34	36	36	.83	32	8	29	36	1.58	32
2	4	30	17	.75	31	3	13	12	1.58	32.5	36	36	36	.75	32	5	25	36	2.00	32
3	4	21	21	.92	32½	2	11	12	1.83	32.5	36	36	36	.75	33	6	20	36	1.58	32
4	3	27	27	.83	32	3	7	12	1.75	33	36	36	36	.71	32	7	20	36	1.42	31
5	3	16	19	1.25	32	3	7	12	1.83	33.5	36	36	36	.67	32	5	28	36	1.33	32
6	3	6	13	1.42	31	2	6	8	2.08	33	36	36	36	.67	32	8	30	36	1.17	32
7	2	5	9	1.58	31	2	7	7	1.50	33	36	36	36	.62	32	6	17	36	1.00	32
8	2	5	7	1.42	32	3	7	8	1.42	33	36	36	36	.62	32	10	20	32	.83	32
9	3	4	4	1.42	32	3	6	8	1.33	33	36	36	36	.58	32	11	24	27	.83	32
10	3	6	4	1.33	31	4	6	7	1.33	33	36	36	36	.54	32.5	20	20	35	.75	32
11	3	6	3	1.33	31	6	9	6	1.29	33	36	36	36	.50	32	25	21	33	.67	32
12	3	6	2	1.33	32	7	9	7	1.25	33.5	36	36	36	.50	31.5	30	30	36	58	32
13	2	6	3	1.25	32	7	10	9	1.33	33	36	36	36	.50	31.5	33	34	36	.54	32
14	3	6	3	1.25	33	12	13	10	1.33	33	36	36	36	.50	31.5	35	32	36	.50	31.5
15	3	6	3	1.25	32.5	12	14	11	1.29	33	36	36	36	.46	31.5	36	33	36	.42	31
16	4	7	3	1.33	32	13	16	12	1.29	33	36	36	36	.46	31.5	36	36	36	.33	31
17	3	7	3	1.83	32	14	17	13	1.29	33	36	36	36	.46	31.5	36	36	36	.29	31
18	3	7	3	1.25	32	14	19	13	1.42	33	36	36	36	.46	31.5	36	36	36	.33	31
19	4	8	4	1.17	32	10	21	14	1.25	33.5	36	36	36	.46	31.5	36	36	36	.33	31
20	5	8	4	1.08	32	11	24	14	1.50	32.5	36	36	36	.42	31	36	36	36	.25	31
21	7	9	4	.67	31	14	24	17	1.42	32.5	36	36	36	.42	31	36	36	36	.25	31.5
22	7	10	4	.58	31.5	17	27	21	1.42	32.5	36	36	36	.37	31	36	36	36	.29	31
23	8	17	5	.58	32	22	25	27	1.33	32	30	36	36	.37	32	36	36	36	.21	31
24	9	18	6	.50	32.5	19	25	32	1.83	32	36	36	36	.37	32.5	36	36	36	.12	30
25	11	17	6	.50	33	28	28	36	1.83	32	36	36	36	.42	32	36	36	36	.10	32
26	12	17	7	.58	31.5	28	30	36	1.17	32.5	36	36	36	.46	32	36	36	36	.08	31
27	12	17	7	.58	32	31	31	36	1.08	32	36	36	36	.46	32	36	36	36	.08	31
28	14	16	7	.67	32	33	33	36	1.08	32	19	36	36	1.58	32	6	36	36	.12	31.5
29	10	13	7	1.00	33	33	33	36	1.00	32	22	25	36	1.42	33	4	36	36	.25	31
30	8	18	8	1.25	32	34	33	36	.92	32	4	22	36	1.42	32	20	36	36	.33	31
31	8	20	9	1 25	32.5	......	......	......	......	......	4	25	36	1.50	32.5	......	......	......	......	......

From this table it may be seen that the water flowed over the dam 289 days and was below it 76 days.

The greatest depth over the dam was on January 18, when the depth was 2.33 feet, and the least was August 29 and 30, when the water was 5 inches below the crest.

From this table is compiled the following table of pressures:

Month.	Number of days on which the morning pressures were—												Average pressures.
	28½ pounds.	29 pounds.	29½ pounds.	30 pounds.	30½ pounds.	31 pounds.	31½ pounds.	32 pounds.	32½ pounds.	33 pounds.	33½ pounds.	34 pounds.	
1884.													
July								27		4			32.13
August								15		16			32.52
September				10		11		2		3		4	31.33
October				6		18		7					31.03
November						3	6	17	4				31.87
December	1	3	1	2		1	3	14	2	1			31.30
1885.													
January			1	3	1	11	2	8		5			31.45
February				2	1	16	5	4					31.14
March						6	2	16	5	2			31.92
April								8	6	13	3		32.68
May						3	8	15	3	2			31.89
June				1		13	3	13					31.45

The pressures for 1885 are considerably below those of 1884 and previous years. This is due largely to the fact that the receiving reservoir has been kept out of the circuit and the city deprived of the benefit to be derived from its use. This reservoir is kept out of the circuit for reasons which will be explained hereafter.

The following table gives a summary of the comparative clearness of the water at the Great Falls and the receiving and distributing reservoirs:

Name of source.	Number of days the water was—			
	Clear.	Slightly turbid.	Turbid.	Very turbid.
Great Falls	173	14	52	126
Receiving reservoir	203	50	40	72
Distributing reservoir	211	20	53	81

Explanation.—22 to 36 is clear, 15 to 22 slightly turbid, 8 to 15 turbid, and 0 to 8 very turbid.

PERSONAL.

John S. Ellis is general superintendent of the Aqueduct. He has been connected with the work since 1866.

Thomas Sullivan is gatekeeper at the Great Falls, which position he has filled since June, 1865.

John Halloran is keeper at the receiving reservoir, which position he has filled since August, 1864.

Daniel Harrington is keeper at the distributing reservoir, to which position he was appointed February 4, 1884, to succeed his father.

IMPROVING THE CONDITION OF THE WATER SUPPLY.

Improvements at the Great Falls.—The Chesapeake and Ohio Canal runs along the left bank of the Potomac River, from which it derives its water supply by means of various dams and feeders. At different points along the canal are waste and discharge weirs for the purpose of regulating the depth of water in the canal, to discharge storm waters, and to empty the locks when desired.

The canal-level opposite the inlet to the Aqueduct is 2 miles long, and is supplied with three overfall waste weirs and one discharge weir, of which all but one overfall weir discharges into the river above the Aqueduct inlet.

The fact that water from the canal in varying quantities was constantly running into the river above the Aqueduct inlet was made, during May and June of this year, the occasion of a great deal of newspaper agitation and caused popular apprehension that the water supplied to the city was dangerously polluted by the water from the canal.

Recognizing the great desirability of allaying all apprehension, steps were immediately taken to effect an understanding with the canal authorities looking to a change in their hydraulic arrangements, whereby the canal water from this 2-mile level would not discharge into the river above the Aqueduct inlet.

On the 2d day of June I met the President and Directors of the canal at the Great Falls, and we went over the ground together and decided upon a plan by which our ends would be accomplished and the canal not injured. This plan was to close the discharge weir and two waste weirs permanently, and to construct *below* the Aqueduct inlet and above the head of Lock 20 a new discharge weir, which would accomplish the same purposes as those to be destroyed. This plan was subsequently ratified by you, and the following agreement made:

AGREEMENT BETWEEN THE UNITED STATES, ACTING BY MAJ. G. J. LYDECKER, OF THE CORPS OF ENGINEERS, UNITED STATES ARMY, AND THE CHESAPEAKE AND OHIO CANAL COMPANY, BY L. VICTOR BAUGHMAN, ITS PRESIDENT.

"It is agreed between the parties aforesaid that in order that the United States may be enabled to prevent any flow of water from the 2-mile level of the canal, just above Lock 20, into the Potomac River above the Aqueduct inlet, it is hereby agreed that the discharge or waste weir about 400 feet above Lock 20, and the two waste weirs, or tumbling dams, next above the Aqueduct inlet shall be closed.

"It is also agreed that a new discharge or waste weir, of one-third greater capacity than the one destroyed, shall be built between Lock 20 and the Aqueduct inlet, to enable the level to be properly discharged into the river below the dam.

"All expenses for materials and wages to be incurred in making these changes are to be paid by the United States.

"The work shall be done by the Chesapeake and Ohio Canal Company under and subject to the inspection of the United States engineer in charge of the Aqueduct.

"Witness the signatures of the parties hereto this 10th day of June, 1885.

"THE CHESAPEAKE AND OHIO CANAL,
"Per L. VICTOR BAUGHMAN, *President.*
"G. J. LYDECKER,
"*Major of Engineers, U. S. A.*

"Witness:
"THOMAS W. SYMONS,
"*Captain of Engineers.*
"S. GAMBRILL,
"*Treasurer Chesapeake and Ohio Canal Company.*"

As soon as this agreement was made, work was commenced in carrying out its provisions, and is still in progress and will be completed as early as possible.

The land between the canal and the river was cleaned of all stables, and, as far as possible, of anything which could cast a suspicion on the purity of the water supply.

The strip of land lying between the river and the canal for about half a mile above the Aqueduct inlet is claimed by the canal company, and is used as a pasture by the people living at the Falls and as a camping-ground by the canal boatmen. In consequence, there is a considerable quantity of animal excreta constantly being deposited thereon, which in times of rain is washed into the river and some of it into the Aqueduct; while under its present ownership there is nothing to prevent people from building houses and making their homes on this land.

The presence of people, houses, &c., on this strip of land along the river bank just above the Aqueduct inlet, or its use as a common for the pasturage of hogs, cows, mules, and horses, should not be allowed, as serious and unpleasant consequences might result therefrom. For the above reasons this strip of land should be under the control of the Aqueduct authorities, in order that it may be entirely closed, and everything kept from it which could by any chance tend to pollute the water. I have therefore the honor to recommend that Congress be asked to pass the necessary legislation to obtain for the United States the ownership of this land. It cannot be purchased at private sale, as the canal authorities are not permitted to sell real estate by their charter. The only method seems to be to condemn it and have it appraised It is unimproved now, and not of great value, and should be secured to the Government before any improvements are made on it.

A plat is submitted herewith showing the area desired. This tract of land contains

11.72 acres. It is so laid out as to leave a tow-path of 25 feet in width along the canal bank, which is sufficient for all the purposes of a tow-path.

If this land can be procured it is designed to inclose it on the canal side and ends with a strong and close wire fence to keep everything from it.

The estimated cost of this improvement is as follows:

11.72 acres land at $50	$586
Expenses of advertising, appraisement, examination of title, &c	200
Wire fence, 3,600 feet, at 8 cents	288
Total estimated cost	1,074

Improvements at the receiving reservoir.—The completion of the alterations at the Great Falls to prevent the inflow of canal water into the river just above the Aqueduct inlet, and the possession by the Government and fencing in of the strip of land lying just above the Aqueduct inlet, between the canal and river, will insure at the inlet a supply of water as good as can possibly be obtained from the Potomac, with all known sources of suspicion removed.

This untainted supply would then be conducted by the conduit to the receiving reservoir, which, as an important feature in supplying the city with water, deserves special attention. This reservoir, capable of holding some 160,000,000 gallons of water, is designed to hold a supply of water in case of any accident to the Aqueduct above it, to equalize and increase the pressure of water as supplied to the city, and to furnish a large and comparatively quiet settling basin where the sediment carried can be deposited during the gentle and slow passage of the waters from the upper to the lower end.

This reservoir is simply the natural valley of Powder Mill Branch, across which a dam has been thrown. The bottom and sides are without paving or puddling, and it receives, besides the waters supplied to it by the conduit, all the waters flowing in Powder Mill Branch, Mill Creek, and the other streams of the basin. Powder Mill Branch has a drainage area of nearly 3,000 acres, and at ordinary times is a stream of considerable size. At times of storm and freshet the volume of water flowing in it is very large, and it brings down with it a great amount of sediment. This sediment, flowing in for many years, has nearly filled the whole upper end of the reservoir and converted it into a marsh unfit for the proper storage of water.

The same thing is true to a lesser degree of the other streams flowing into it. These streams, discharging their turbid floods into the reservoir after every rain and creating strong currents therein, interfere very materially with one of its most important functions—that of a settling reservoir. In order that it should properly and in the most perfect manner fulfill its office as a settling reservoir these streams should be kept out of it, and it should be deepened about the edges and its banks paved with stone.

Besides interfering with the settling of the water in the reservoir, these streams are liable to dangerously pollute it. The country drained by them is becoming more and more populated each year, the number of domestic animals is increasing, and so is the use of fertilizers to a remarkable degree. A map is given herewith of the country draining into the reservoir. It should need no argument to convince anybody of the great desirability of excluding the drainage of this country from the water supply of the city.

The length of these streams is not sufficient to render innoxious the impurities contained in their waters. It is not an uncommon thing for dead animals to be found in these streams, and their presence may be undetected for days.

The recent terrible experience at Plymouth, Pa., shows how necessary and desirable it is to guard in every possible way the water supplied to a community.

The value of this reservoir for settling purposes is chiefly from December to June. During the remainder of the year it has a decided value as a storage basin, and in equalizing and increasing the pressure on the city supply pipes.

In order to render this receiving reservoir as efficient as it is possible and practicable to do, two things should be done as soon as possible—the injury which it has received by the disposition of sediment and the growth of aquatic plants should be repaired by dredging, and the recurrence of this should be prevented by turning the streams which flow into it and causing them to flow around it and discharge directly into a natural water-course below the reservoir. Also certain lands bordering the reservoir should belong to the Government to prevent any use of them which could cause any pollution or fear of pollution.

The accompanying plat and cross-sections show the plan proposed for accomplishing the end desired. There are three main streams entering the reservoir, the waters of which should be diverted. Powder Mill Branch with a drainage area of 2,882 acres, Mill Creek with a drainage area of 968 acres, and East Creek with 230 acres.

The little spring branches entering at the extreme southeastern end of the reservoir are very small, are fed by the purest springs, and are in their whole course within the servoir reservation and constantly under the eye of the keeper, and can in conse- ence be rigidly guarded.

It is not considered that there is any occasion for diverting them now. If at any ne in the future it should seem desirable to keep these spring streams from en- ring the reservoir, it can be done by a simple extension of the plan proposed for the her streams.

The plan proposed is to take the waters of East Creek by an open channel cut in e hillside north of the reservoir to the basin of Mill Creek; then to take the com- ned waters of East and Mill creeks to the basin of Powder Mill Branch by an en cut and tunnel. The combined waters of all the creeks then are to be taken by eans of a tunnel and open cut underneath the conduit, and to the natural water- urse below the reservoir, known as Little Falls Branch. The work is planned so as give the shortest tunnel line possible between the reservoir and Little Falls ranch, and the existing open cut for the conduit waste-weir is utilized.

From examinations of the rock exposed in this waste-weir it is probable that about alf of this new tunnel will be in hard rock requiring no lining, and half will have lined with masonry.

It will have to be deep enough to pass under the conduit without endangering or terfering with the latter, and this renders desirable a drop or vertical shaft at its d near the reservoir. In order to throw the water into the tunnel a dam is to be ilt across the reservoir just above where the conduit discharges its waters. This built here for the reason that the area of the reservoir above it is nearly filled ith sediment and overgrown with plants and weeds, and is unfit for water storage. is desirable also to have a small catchment basin for the storm waters of Powder ill Branch, &c.

The upper end of the reservoir from the located position of the dam for about 800 et has been so filled by sediment that the water is only from 1 to 3 feet deep. The lan proposed contemplates dredging out this to a depth of at least 5 feet, and using e material or as much of it as is needed for building the dam.

The dam is to be rendered water-tight by closely driven sheet-piling and the proper istribution of excavated material.

The good stone excavated from the tunnel will be used in the masonry required and r paving the slopes of the dam and open cuts.

Across the head of the Mill Creek basin a similar dam will be built, and for like easons. The material for this dam will be mostly obtained from the open channel ut from Mill Creek to Powder Mill Branch. It is probable that the tunnel portion etween these two creeks will all require lining. This tunnel is rendered necessary y the fact that the hillside south of it jutting into the reservoir is very steep, rendering an open channel around it very difficult of construction and expensive to maintain.

A small dam will also be built across the head of East Creek, a portion of the material excavated from the open channel cut between it and Mill Creek being used for its construction.

All the channels and tunnels have been computed to carry off a suppositious rainfall of 2 inches per hour, the amount reaching the water-courses being computed by the Burkli-Zeigler formula and the channel ways by Kutter's formula.

There will be needed a tract of land about the lower end of the main tunnel and ut at Little Falls Branch for dumping ground, and to build bulkheads of the excavated material to prevent the adjacent lands from being deluged by the floods which at times must come down through the new channel. This tract is shaded on the plat, and marked A; it contains about three acres.

Along the upper end of the reservoir and lying between it and the conduit road is a strip of land occupied by two families, with out-houses, stables, privies, &c. The land is under cultivation, and is a steep hillside sloping to the reservoir. This land as at present occupied is a constant menace to the purity of the water supply. I would recommend that it be taken for the Government and all buildings and everything of like nature removed, and that nothing be allowed upon it which could by any possibility tend to cause pollution of the water in the reservoir. This tract is shaded on the plat, and marked B.

For similar reasons, and the additional one that the proposed new tunnel passes under it, possession should be obtained of the small triangular area, marked C on the plat, lying north of the conduit.

Another area of land which should pass under the ownership of the Government, and the control of the Aqueduct authorities is the shaded portion lying north of the reservoir and marked D. Through this must pass the tunnel for conveying the waters of Mill Creek to Powder Mill Branch. This area is partially under cultivation, and fertilizers, manures, &c., put upon it are washed in times of storm directly into the reservoir. From its situation it is also liable to be used for purposes still more dangerous to the water supply.

The present boundaries of the lands owned by the Government are too near the water line to permit the proper permanent and most efficient guarding [illegible] voir.

The lands pertaining to the reservoir should be completely and securely [illegible] to prevent cattle, hogs, &c., from getting near and polluting the water. [illegible] cluded in this estimate the cost of a strong wire fence where it is needed.

The banks of the reservoir under the improved plan will be about 10,0[illegible] If left as at present in their natural condition winds and storms must [illegible] to wash these banks, and it becomes muddied to a greater or less degree. [illegible] of the reservoir for settling and storage purposes is in consequence very [illegible] To draw off the water and pave these banks is not now practicable, on [illegible] great and prolonged inconvenience which it would cause to the people of [illegible] ton. These banks can, however, be very effectually protected from wa[illegible] rapping them, and the following estimate includes the cost of doing this.

It is proposed to place the riprap so that its top will be about 2 feet [illegible] water as it generally stands in the reservoir, and its bottom about 5 feet [illegible] line. This will cover from 12 to 15 feet of the bank, the rock to be put o[illegible] 18 inches in thickness. In connection with this it is proposed to go a[illegible] above lines and carefully remove by grubbing all plant growth and shal[illegible] having a tendency to produce it.

[illegible] reasons stated the stream [illegible] [illegible] the water supplied to the c[illegible] [illegible] that they form the only [illegible] [illegible] to the Aqueduct [illegible] [illegible] water being [illegible] [illegible] of the finest qua[illegible] [illegible] water supply to the city, [illegible] [illegible]

[illegible] Powder Mill [illegible] [illegible] so arranged [illegible] [illegible] have planned [illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Mills Branch to Falls Branch—Continued.

avation in open cut near Falls Branch:

Earth, 1,000 cubic yards, at 30 cents	$300 00
Rock, 1,200 cubic yards, at $2.25	2,700 00
e conduit through dam	500 00
	63,691 50

ing banks and dredging reservoir:

rap stone on banks, 5,555 cubic yards, at $1.75	$9,721 25
avation by dredging, &c., in reservoir, 18,750 cubic yards, at 30 nts	5,625 00
	15,346 25

his work there will be required about 6,500 cubic yards of stone for rubble y, paving, packing, concrete, &c.; of this it is safe to assume that 3,000 yards furnished by the excavation, leaving 3,500 yards to be provided:

ne, at $2 per yard, delivered	$7,000 00

and required in accordance with this plan is estimated as follows:

near Falls Branch, 3 acres, at $50 per acre	$150 00
north of conduit road, 4 acres, at $200 per acre	800 00
ments on B	600 00
north of conduit road, 2.6 acres, at $100 per acre	260 00
north of reservoir, 7 acres, at $100	700 00
	2,510 00
es of advertisements, appraisement, surveys, plants, examination es, &c	500 00
	3,010 00
nce about reservoir, 9,975 feet, at 6 cents	598 50
	3,608 50

xpenses for engineering, including surveying, platting, drawing, inspection, ork, clerks, &c., will probably be about $8,000.

estimate, summarized, is as follows:

eek to Mill Creek	$6,781 54
eek to Powder Mill Branch	22,593 50
Mill Branch to Falls Branch	63,691 50
ing banks and dredging in reservoir	15,346 25
	7,000 00
	3,010 00
	598 50
ering	8,000 00
	127,021 29

round numbers, and to provide for contingencies, $130,000. This sum is be- o be ample to put the receiving reservoir into a perfectly good and healthy on, and insure its freedom from pollution by the waters now draining into it e surrounding country. During the present summer the water from the Great as been conducted around this reservoir in order to guard against any harm lone by taking it through. The result has been a certainty that the water is m any possible contamination from this source, but this has been obtained at t of a material diminution of pressure on the city water-pipes.

water in the Upper Potomac is, without doubt, as pure and wholesome as can d in any river, and when this is brought to the city absolutely free from con- tion or pollution from any other sources, Washington will have a supply of nexcelled in quality and above suspicion. The measures now in progress and ended at the Great Falls and the plan proposed for improving the receiving ir will remedy all known existing evils in the arrangements for bringing the of Potomac water to the distributing reservoir.

e, therefore, to recommend that in addition to the usual $20,000, for the care intenance of the Aqueduct, Congress shall be asked to pass the necessary leg- and appropriate money as follows:

d and fencing at Great Falls	$1,074
proving receiving reservoir	130,000

The distributing reservoir.—In the early part of June, 1885, the water supplied to th city became exceedingly offensive, having a slightly greenish color and a strong oily fishy smell.

In many other cities the same thing was observed.

It has occurred here before on several occasions, particularly in 1875. Investig tion has shown that it is caused by the decomposition of myriads of minute fibro aquatic plants which are generated and thrive on the surface of bodies of quiet wate under favoring meteorological conditions. These minute microscopical plants ar generated principally in the spring, when the air is swarming with the germs of an mal and vegetable life. There are various species of fresh-water algæ however, th thrive at all seasons of the year. There is nothing more certain than that all th waters of rivers, lakes, or reservoirs which are subjected to the action of the atmo phere are continually having their plant and animal life replenished by germs there from. If the water remains stagnant, this life multiplies and becomes of higher order If, however, the water is agitated and tossed about as in a swiftly running river or wind-beaten lake, these germs and minute plants and animals are broken up, dis solved, and returned through oxidation to the original elements and their inorgan compounds. In our own case this spring, the weather was warm and the air was quie for a number of days preceding and during the prevalence of the disagreeable odor, and everything in the condition of air and water was conducive to the growth of living organisms. The waters of the reservoir thus filled with life were drawn off by the main pipes and distributed throughout the city.

In the pipes the minute plants, &c., were broken up and destroyed, and owing to the absence of air and circulation gave off their gaseous emanations to the water in the disagreeable form so noticeable.

The first storm which came broke up this quiet growth on the reservoir, the air carried away the gaseous products, and the fishy odor disappeared.

This offensive odor in the water caused great apprehension to the people of Washington as well as a very large aggregate expense, and must continue to do so at every occurrence thereof.

While it is not ascertained and is not believed that the bad condition of the water as evidenced by its smell is the cause of any serious illness, yet at the same time it may not be without its effect on delicate persons and in aggravating the malaria so prevalent in Washington.

In view of this fact the question arises as to whether there are any available means of preventing it. Study and observations of nature's methods of purification it is believed reveal the answer to this question. Swift mountain streams tumbling over falls and rapids and being dashed to foam among rocks are always far more free from organic impurities than are the same streams flowing sluggishly through the valleys. The constant motion of the water prevents all quiescent growth and continually brings the watery particles into contact with the air.

It is a fact recognized by the highest authorities that the waters of a stream are purified by running in their natural courses. The sewerage of a city flowing into a river is so acted upon that at a short distance below no trace of it can be discovered by chemical processes.

The means by which this purification is brought about are due to bringing all contained impurities in contact with the air, from which results oxydation, carbonization, &c., and the resulting elements and inorganic compounds there being deposited on the bottom or borne away by air currents. The process depends primarily and essentially on the aeration of the water, and to purify and keep pure the waters of a quiet reservoir some method of aeration must be adopted.

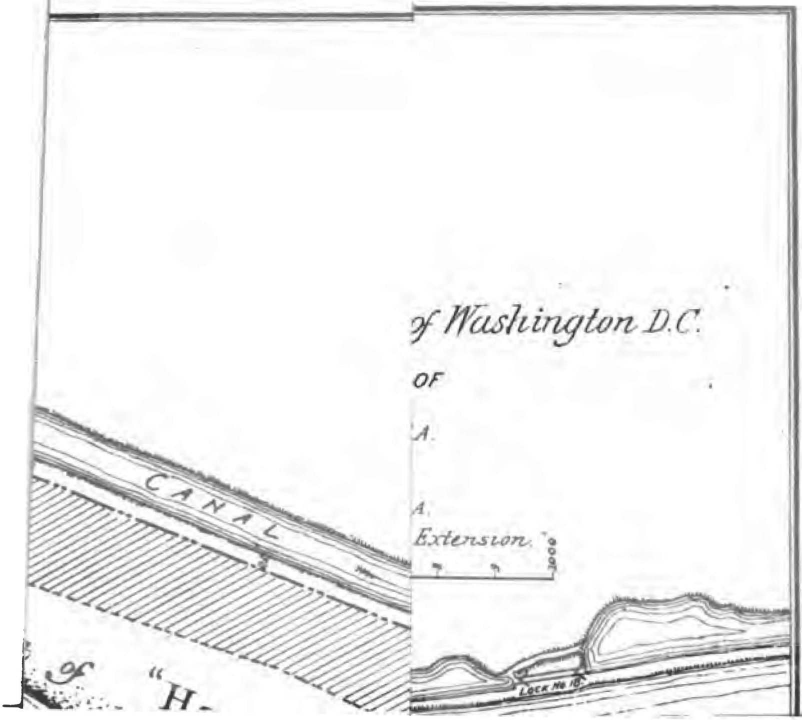
The artificial aeration of water as a means of increasing its purity and destroying deleterious organic matter is receiving attention from those having charge of the water supply of cities, and some very beneficial results have been obtained from its adoption. In our own case the necessity of adopting a system of aeration and the proper system to adopt is yet undetermined.

A very simple plan would be the disposition over the bottom of the distributing reservoir of a system of perforated pipes, by the medium of which air could be forced into and through the overlying water. The water would be kept in continual agitation in contact with the air, which, in escaping to the surface would perform its beneficial operations on all contained impurities, and carry away all gaseous emanations into the overlying mass of air. If the water in this reservoir should be constantly aerated, it would constitute a safeguard through which it would be scarcely possible for any dangerous elements to reach the city, even though they might be prevalent in the Potomac at the source of supply.

FINANCES OF THE AQUEDUCT.

The amount appropriated for the maintenance of the Aqueduct for the fiscal year ending June 30, 1885, was $20,000, all of which was expended.

The same amount was appropriated for the fiscal year ending June 30, 1886. The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expensive works of repair and change at the Great Falls will make serious inroads on this sum, and if anything unusual should occur during the year demanding much expenditure, a deficiency would be the result.

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain of Engineers.

Maj. G. J. LYDECKER,
Corps of Engineers, U. S. A.

U U 2.

INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA.

At the commencement of the year operations on the several parts of this work were in progress as follows:

(*a*) Construction of masonry dam at the Great Falls, under contract with Chittenden Brothers.

(*b*) Construction of tunnel, under contract with Beckwith & Quackenbush.

(*c*) Construction of reservoir near Howard University, under contract with Maloney & Gleason.

(*d*) Main connections comprising the work of laying 48-inch and 75-inch mains for introducing the water from the new reservoir into the system of supply mains, executed by day labor.

A detailed history of the year's operations will be found in Captain Symons's report, which is transmitted herewith, so that it is unnecessary for me to do more than summarize the results.

DAM AT THE GREAT FALLS.

This work consists in placing a coping 15 inches thick on the old dam across the Maryland Channel of the river, a distance of 1,034 feet, and in constructing a dam in extension of this one across Conn's Island and the Virginia Channel of the Potomac to the Virginia shore. This extension is 1,843 feet long and varies from 4 to 20 feet in height.

At the beginning of the year the bed courses of the dam had been placed across Conn's Island, a distance of about 700 feet, and the dam completed to the bed of the coping course for about one-third of this distance. Preparations for commencing that portion of the dam crossing the deep water of the Virginia Channel at the most difficult part of the work were also in progress.

Work was continued until about the middle of December, when natural causes necessitated a suspension of operations until the spring; in the mean time the dam across Conn's Island has been completed, as also a short-length extending from the Virginia shore to the deeper water of the Virginia Channel, but in this part the contractors had only succeeded in constructing the auxiliary coffer-dam. Work was resumed about the middle of March, and by the close of the fiscal year the deep-water sections of the dam were completed, except coping.

The time for completing the work, as fixed by the contract, was June 30, 1885, but the contractors having failed to complete the work at that date, have received an extension of time until November 1, 1885.

The total estimate of work done to June 30, 1885, is as follows:

503 cubic yards coping masonry, at $24.50	$12,323 50
1,474 cubic yards cut-stone masonry, at $20.75	30,585 50
2,360 cubic yards concrete masonry, at $5.50	12,980 00
525 cords riprap backing, at $7.25	3,806 25
11,368 pounds wrought-iron drift-bolts and cramps, at 7 cents	795 76
5,695 cubic yards excavation, at $1	5,695 00
9,500 square yards area cleared, at 5 cents	475 00
Extra materials and labor:	
224 cubic yards concrete masonry, at 50 cents	112 00
40 barrels Portland cement, at $2.70	108 00
For making deflecting dams, coffer-dams, sluices, and all other auxiliary works required, as per supplemental contract	15,000 00
	81,881 01
Less 10 per cent. retained	8,188 11
Amount paid contractors	73,692 90

Of this above amount $58,518.01 is for work done and accepted during the past fiscal year.

There remains to complete the work the construction of about 400 feet of dam with an average height of 6 feet, to connect the dam on Conn's Island with the deep-water section of the Virginia Channel, and the placing of about 1,100 linear feet of coping.

The original appropriation for this part of the work was $145,151, of which the sum of $88,600.05, including expenses of engineering, &c., retained percentages, and outstanding liabilities, had been expended to June 30, 1885.

The balance available is $56,550.95, and is sufficient to complete the work.

TUNNEL FOR AQUEDUCT EXTENSION.

This work, when completed, will be 20,715 feet long, with a normal cross section of 82½ square feet; its average depth below the surface of the ground is about 150 feet.

At the beginning of the fiscal year the five working shafts, aggregating 512.9 feet in length, had been excavated. The shortest shaft is 58.6 feet deep, and the longest 160 feet. At the same date 1,591 linear feet of tunnel had been excavated.

During the past year 11,907 linear feet of tunnel have been excavated, making the total length 13,498 feet on June 30, 1885; of this length 745 feet has been lined with masonry.

The three permanent air-shafts, aggregating 530 feet in length, were completed during the year, and also the masonry lining of the east and west working shafts, which are to constitute the terminal connections of the tunnel with the old and new distributing reservoirs. The work has been carried on by the contractors with care and skill, and while it is my judgment that more progress could have been made, I am satisfied that the conditions were such as to prevent the completion of the work within the period of time originally fixed by the contract; the time for completion has accordingly been extended to June 30, 1886. The total estimate of work done to June 30, 1885, is as follows:

42,510 cubic yards excavation in tunnel, at $8	$340,080 00
2,148¾ cubic yards earth excavation in shafts, at $6	12,892 50
2,676 cubic yarrds ock excavation in shafts, at $10	26,760 00
938.89 cubic yards brick masonry in tunnel, at $14	13,144 46
319.28 cubic yards concrete masonry in tunnel, at $5	1,596 40
1,730.72 cubic yards dry stone packing in tunnel, at $2.50	4,326 80

383 cubic yards brick masonry in shafts, at $18	$6,894 00
600 cubic yards concrete masonry in shafts, at $5	3,000 00
930 cubic yards dry stone packing in shafts, at $2.50	2,325 00
444 linear feet air-shafts, complete, at $15	6,660 00
297 cubic yards extra excavation in tunnel, at $1.50	445 50
	418,124 66
Less 10 per cent. retained	41,812 47
Amount paid contractors	376,312 19

Of this amount $339,768.16 is for work done and accepted during the past fiscal year.

The original appropriation for the extension of the Aqueduct was $599,534.55, of which there has been expended to June 30, 1885, the sum of $438,722.53, including retained percentages, outstanding liabilities, expenses of engineering, superintendence, &c. The balance available for completing the work is $160,812.02.

During the early part of the year, as soon as the work of excavating in the several headings of the tunnel had progressed sufficiently to develop the character of the rock and the effect of its exposure to air and water, it became evident that the cost of completing the tunnel would largely exceed the original estimate and the amount appropriated for the work.

Accordingly, I have caused a careful estimate to be prepared, based on the experience had in the progress of the work up to the close of the last fiscal year.

The details of this new estimate, together with a full explanation of the causes whereby it is found so much greater than the original, are clearly set forth in the accompanying report of Captain Symons, who has had throughout the immediate superintendence of the work. This report establishes conclusively that an additional appropriation of $393,887.51, or in round numbers $395,000, is required to complete the work. The estimate on which the appropriation made by Congress was based was prepared in the office of the Engineer Commissioner for the District of Columbia. This estimate contemplated in general terms the extension of the Aqueduct by "a 9-foot conduit from the distributing reservoir to an available site for another reservoir east of Seventh street."

The report of Capt. R. L. Hoxie, Corps of Engineers, U. S. Army, assistant to the Engineer Commissioner for the District of Columbia, dated October 10, 1879, wherein this project is submitted, states:

> Rock Creek may be crossed either by a gang of large cast-iron mains laid as syphons through the bed of the creek, or by a tunnel through the compact rock which underlies this stream. If borings in this rock are satisfactory the latter method is, I believe, the best and cheapest.
>
> * * * * * * *
>
> The line is so located that the conduit rests throughout on the natural ground when not in tunnel, and is protected, when covered by embankments, by side walls computed to resist independently the entire water pressure.

The same report places the estimated cost of the conduit at $545,031.41, itemized as follows:

Excavation:	
24,940 cubic yards rock, at $6	$149,640 00
4,930 cubic yards rock, at $8	39,440 00
1,564 cubic yards rock, at $3	4,692 00
42,847 cubic yards earth, at $3	128,541 00
	322,313 00

Masonry:		
1,225 cubic yards, at $5	$6,125 00	
400 cubic yards, at $5.50	2,200 00	
6,498,207 bricks, at $30 per M	194,946 21	
		$203,271 2
Timber:		
972,360 feet, B. M., at $20 per M		19,447 2
Total for conduit		545,031 41

It is stated that the estimates "are necessarily approximate but will cover reasonable contingencies." (See House Ex. Doc. No. 1, part 6, Forty-sixth Congress, second session, Annual Report of the Commissioners of the District of Columbia for 1879, pages 379, 380, 381.)

The appropriation for the work was made about three years after the date of this report, the above estimate being increased 10 per cent on the recommendation of the Engineer Commissioner of the District of Columbia, in order to make allowance for the rise that had in the mean time taken place in the value of labor and material. This increase of 10 per cent. made the appropriation $545,031.41+$54,503.14=$599,534.55, the amount named in the act for increasing the water supply, approved July 15, 1882. This act developed the responsibility of constructing the several works named therein upon the Secretary of War, notwithstanding no estimate or plan for the work had ever been considered or presented by that Department; so far as relates to the conduit, he was simply directed "to extend the Washington Aqueduct from its present eastern terminus to the high ground north of Washington near Sixth street extended." I was assigned to the work with Captain Hoxie, detailed at my request to assist me, and at once entered upon an examination and study of the question with a view to determining the best method of extending the Aqueduct; the final result was the adoption of the tunnel method, a continuous tunnel in a straight line between terminal points located at such depths as to insure, so far as practicable, its construction in solid rock throughout.

The estimated cost for this work was based upon the following estimate of quantities of work to be done:

64,000 cubic yards excavation in tunnel.
1,500 cubic yards earth excavation in shafts.
1,200 cubic yards rock excavation in shafts.
250 cubic yards brick masonry in shafts.
660 cubic yards concrete masonry in shafts.
400 cubic yards dry stone packing in shafts.
420 linear feet air shafts, complete.

The total cost of the work indicated above, at the prices bid by the contractors to whom its execution was awarded, was $548,100, leaving a balance of $51,434.55 available for lining whenever required, engineering, contingencies, &c., and with the information then available it appeared to be sufficient. As the work advanced, however, it was found that the shafts had to be sunk to greater depths, in order to reach good rock, and that the varying character of the rock developed in excavating the tunnel would require its being lined to a much greater extent than had been anticipated; a great increase in the amount of excavation has thereby resulted, of which no account was taken in the original estimates, as well as in the amount of masonry to be placed as lining. Besides the original estimates did not allow for the works necessary for connecting the inlet shaft at the westerly end of the tunnel with the receiving reservoir, nor contemplate the completion of all the working shafts in such a manner as to admit of their future use in flushing the tunnel or in draining and repairing it if necessary, a course which, from the nature of the rock excavated, has become a precautionary measure of the greatest importance.

I have carefully examined the new estimate submitted in Captain Symons's report, and am satisfied that everything in it is likely to be required for the completion of the work. I would therefore urge the importance of the appropriation of the additional sum of $395,000 for completing the extension of the Washington Aqueduct. The appropriation under which operations are now being carried on will be exhausted by or before February 1, 1886, and a new appropriation must be available by that date in order to continue the work without interruption, thereby avoiding a large increase in expense that must necessarily attend a suspension and resumption of work of this character, as well as delay in its completion.

NEW RESERVOIR.

This work involves as its main feature the excavation of about 850,000 cubic yards of earth, and its embankment at the lower end of the valley in which the reservoir is located, in such manner as to form a massive earthen dam.

The top surface of the dam is designed to be at an elevation of 160 feet above tide, which will be 15 feet above the water surface of the reservoir and 45 feet above the general level of its bottom; the head of water against the dam will be about 30 feet.

The thickness of the dam at the water-line will be 250 feet, and at the bottom about 425 feet. The side slopes of the reservoir and interior slopes of the dam will be paved with dry stone. In addition to the above, the project involves the construction of side channels and by-washes to carry the flow of streams that now pass through the site of the reservoir and to intercept all surface drainage.

At the beginning of the fiscal year the work was well under way and estimates for work to the amount of $54,314.54 had been made to the contractors, the principal item being 142,521 cubic yards of excavation at a cost of $42,756.30, or 30 cents per cubic yard, including the embankment of the excavated material in the dam, as required by the contract. During the year the contractors had a considerable force and plant employed, but not such as to accomplish anything like the amount of work called for by the contract; what they have accomplished, however, has been well and thoroughly done, and as the reservoir can be of no use until the tunnel is completed, no evil has resulted from the slow progress, and the contract time for completing the work has been extended to July 1, 1886, the date fixed for the completion of the tunnel.

The total work accomplished by the contractors to June 30, 1885, is as follows:

495,296	cubic yards excavation, at 30 cents	$148,588	80
37,125	cubic yards puddling, at 40 cents	14,850	00
2½	cubic yards cut-stone masonry, at $15	37	50
312	cubic yards brick masonry, at $9	2,808	00
3,715	cubic yards concrete masonry, at $5.50	20,432	50
79	cubic yards rubble masonry, at $6	474	00
1,257	square yards trap-rock lining, at $1	1,257	00
3,116	cubic yards broken-stone lining, at $2	6,232	00
19,692	square yards paving, at 28 cents	5,513	76
228	linear feet cast-iron drains, at 75 cents	171	00
7,500	feet, B. M., pine plank, at $30 per M	225	00
		200,589	56
Less 10 per cent. retained		20,058	96
Amount paid contractors		180,530	60

Of which the sum of $146,275.02 is for work done during the past year.

At the close of the year the dam was completed to a height of about 27 feet above the general level of the bottom of the reservoir; the east flood channel, conduit, and by-wash had been completed; the west conduit, involving at its greatest depth the excavation of a trench 52 feet deep, was completed for a length of 1,177 feet; the interior slopes on the east side of the reservoir were paved over 2,231 feet of its length.

For further details of operations during the year, attention is invited to the accompanying report of Captain Symons.

The appropriation for this work was $431,273.75, of which there had been expended to July 1, 1885, the sum of $251,118.93, including contractors' retained percentages, oustanding liabilities, expenses of engineering, superintendence, &c.

The balance available for the work is $180,154.82, and is not sufficient for its completion. The estimate on which the original appropriation was based, was made in advance of the preparation of any detailed plan for the work, and was furnished to Congress in 1879 by the Engineer Commissioner of the District of Columbia, as before explained in this report in relation to the tunnel.

When the detailed plan was prepared, after the execution of the work had been ordered by Congress, every effort was made to have it such as to bring the cost of its essential parts within the limits of the amount appropriated, and that this would be the case it was assumed from the following estimate, the prices used being those bid by the contractors to whom the work was awarded:

695,000 cubic yards excavation, at 30 cents	$208,500
54,000 cubic yards puddling, at 40 cents	21,600
20,000 square yards sodding, at 20 cents	4,000
12 cubic yards cut-stone masonry, at $15	180
250 cubic yards brick masonry, at $9	2,250
3,500 cubic yards concrete masonry, at $5.50	19,250
100 cubic yards rubble masonry, at $6	600
1,400 square yards trap-rock lining, at $1	1,400
8,000 cubic yards broken stone lining, at $2	16,000
80,000 square yards paving, at 28 cents	22,400
95 linear feet coping, at $5	475
3,100 linear feet cast-iron drains, at 75 cents	2,325
Total	298,980

The appropriation being $431,273.75, this estimate indicated that there would still remain the sum of $132,293.75 available for building the gate-house and for meeting all expenses of engineering and other contingencies pertaining to this item of appropriation.

But the developments of the past year have shown that this cannot be so, and the reasons are set forth at length in Captain Symons's report, which contains a carefully prepared estimate of the cost of completing the reservoir with all its accessories in a proper shape.

To accomplish the work indicated in that estimate, an additional appropriation of $195,000 in round numbers will be required.

The necessity for this additional appropriation is attributable to several causes, the principal ones being as follows: (1) As the excavation for the reservoir has proceeded, a considerable amount of material of a character unfit to constitute its side slopes and bottom has been uncovered; this material should be removed to a sufficient depth and be replaced with other of a suitable character, generally puddled clay; a large increase in the items of excavation and puddling will thereby result; (2) it was expected to supply most of the stone required for paving from that taken from the tunnel through the east shaft at the site of the reservoir, but this stone has been found to be entirely unfit for that purpose, and a large expense for bringing suitable stone to the site of the reservoir is the consequence; (3) the original estimate contemplated taking the ordinary flow and sewage of the several streams crossing the site of the reservoir through iron pipes laid in its bottom and imbedded in concrete, and carrying all storm flow in excess of the capacity of these pipes around the reservoir through open flood channels; on further consideration this plan has been deemed decidedly objectionable, and a modified project has been adopted for reasons stated in my letter dated June 29, 1885, and in the report of the Board of Engineers, dated July 24, 1885, copies of which are given below; the increased cost due to this modification is in round numbers $40,000; (4) the character of the work requires the employment of a considerable engineering and superintending force calling for larger expenditures for this purpose than was of any apparent necessity before the work began; (5) it was intended at first to admit the water into the reservoir at one point only, but the vital importance of introducing it in such a way as to cause a free circulation of the water through the reservoir was left out of consideration, and the revised estimate covers the cost of the work necessary for accomplishing this. For the five reasons given above an additional appropriation of not less than $160,000 is required.

None of this work can be dispensed with, as it relates to what must be done as an absolute necessity before the water can be introduced and stored in the reservoir with due regard to security and purity.

Captain Symons's estimate includes other items which are necessary for a proper completion of the work, but which, as compared with the foregoing, are of secondary importance. They refer to the construction of a suitable house for the keeper, who will be put in charge of the reservoir, and to properly fencing the reservoir reservation. The estimated cost for these two items is, for the keeper's dwelling, $5,000, and for fencing, $28,240. This work can be done after the reservoir is completed in all other respects, and therefore the immediate appropriation of the money required for it is not called for.

But it is far different as concerns the money necessary for completing the reservoir so that it can be used at all; this, as before shown, will require an additional appropriation of $160,000, and such additional appropriation should be made at the next session of Congress and at such a time as to prevent any interruption of the work now in progress.

MAIN CONNECTIONS.

The purpose of this work is to take the water from the new reservoir into the system of supply mains for the city, comprising as its principal feature the laying of about 662 feet of 75-inch cast-iron mains, 6,645 feet of 48-inch mains, and 564 feet of 12-inch mains, all with the necessary connections, water-gates, and gate-houses.

At the commencement of the last year about 3,600 linear feet of the 48-inch main had been laid. This work was continued the remaining distance of 3,045 feet to the point at which the gates and connections with the 75-inch outlet main was made; a large valve-chamber was made here, and all work completed up to that point about the middle of October, 1884. Since then, 527 linear feet of the 75 inch main has been laid, substantially completing this part of the work, except that required for making final connection with the effluent gate-house, which will not be constructed until the new reservoir approaches completion.

The total amount expended on account of main connections to J 30, 1885, was as follows:

For water-pipe, valves, and special castings	$122,025
For pay-rolls for labor, superintendence, &c	25,025
For materials, tools, supplies, &c	11,434
For hauling pipe from depots, &c	3,919
	162,406

Of which the sum of $22,176.69 was applied during the past fisc year.

The balance available is $2,993.88, which will probably suffice t complete what remains to be done.

LAND.

The several provisions of law relating to the acquisition of land take for the purpose of this improvement will be found in the acts of Co gress named below:

(1) Act approved July 15, 1882, which authorizes condemnation all land needed, specifies the methods of settlement, and appropriat $131,620 to be applied thereto.

(2) Deficiency appropriation act, approved July 7, 1884, appropriat $87,500 to pay for land for reservoir.

(3) Act approved February 26, 1885, extends time for making settl ment with owners of land taken.

(4) Deficiency appropriation act, approved March 3, 1885, appropri ates $87,500 to pay for land for reservoir.

The following list shows all the payments which have been made o account of land up to June 30, 1885. The deeds have been duly re corded and returned, with their accompanying papers, to the Enginee Department for file:

Payments on account of lands to extend aqeducts.

Names, &c.	Date.	Amount
Otis S. Presbrey	July 9, 1884	$1,336
Evan Lyons	Aug. 15, 1884	3,500
Albert T. Shurtleff	Sept. 1, 1884	1,194
Abram P. Fardon	Apr. 22, 1885	1,576
Howard University	Apr. 22, 1885	380
Edward L. Dent	May 8, 1885	506
John Sherman, trustee	May 8, 1885	634
Helen Rand Tindall	May 18, 1885	1,215
Le Roy Tuttle	May 18, 1886	1,327
William Linkins	May 27, 1885	120
		11,968
District attorney, services		1,117
Monument stones and erecting same		160
Expenses of appraisers		36
Recording deeds		21
		13,306

Payments on account of land for reservoir.

Names, &c.	Date.	Amount.
aty M. C. Seiler	May 19, 1884	$1,540 00
ate C. Dowling	May 22, 1884	1,088 00
. L. Thomas and M. Stanton	May 31, 1884	1,175 00
Margaret Finn Hallig	June 4, 1884	2,465 00
Charles M. McKenney	June 6, 1884	935 00
Charles B. Purvis	June 9, 1884	3,062 50
Meredith Eatman	June 20, 1884	1,750 00
George and Wilson Grice	June 21, 1884	1,425 00
Benjamin R. Hodges	July 7, 1884	640 00
Diana Walker	July 7, 1884	1,150 00
Elmira G. Wheeler	July 7, 1884	1,300 00
John Walker	July 7, 1884	1,785 00
James B. Johnson	July 9, 1884	5,962 50
John A. Pierre	July 10, 1884	1,300 00
Anna L. Woodbury	July 16, 1884	1,326 00
William Harris	July 28, 1884	450 00
Almos P. Bogue	Aug. 4, 1884	1,300 00
Charles F. Cost	Aug. 6, 1884	1,300 00
John O'Connell	Aug. 9, 1884	3,500 00
Howard University	Sept. 1, 1884	18,294 10
Almos P. Bogue	Sept. 1, 1884	1,375 00
William Walker	Sept. 1, 1884	1,300 00
H. Wolford and M. Shilberg	Sept. 1, 1884	1,300 00
Adeline Brooks	Sept. 1, 1884	900 00
Jacob Kau	Sept. 1, 1884	750 00
Francis H. Smith, trustee	Sept. 1, 1884	444 00
Nancy Richards	Sept. 4, 1884	1,300 00
John M. Brown	Nov. 18, 1884	8,625 00
Howard University	Apr. 22, 1885	88,549 20
Lawrence Hickey	Apr. 24, 1885	3,125 00
George E. Moore, sr	Apr. 27, 1885	44,733 00
		204,149 30
District attorney, services		1,500 00
Office pay-rolls		936 67
Appraisers' services		405 00
Monument stones and erecting same		143 00
Recording deeds		66 00
Expenses of appraisers		46 50
		207,246 47

PAYMENTS ON ACCOUNT OF "WATER-RIGHTS AND LAND TO EXTEND DAM AT GREAT FALLS."

Monument stones and erecting same	$102 96
Expenses of appraisers	15 00
	117 96

The following is a money statement for the fiscal year ending June 30, 1885:

Title of appropriation.	Available July 1, 1884.	Expended during the year.	Amount unexpended June 30, 1885.	Outstanding liabilities including retained percentages.	Available June 30, 1885.
Land to extend Aqueduct	$51,370 00	$13,298 25	$38,071 75	$852 90	$37,218 85
Extension of Aqueduct	535,171 76	297,617 73	237,554 03	76,742 01	160,812 02
Main connections	25,170 57	21,948 47	3,222 10	228 22	2,993 88
Land for reservoir	*196,802 95	193,799 42	3,003 53	10 00	2,993 53
Constructing reservoir and gate-house	369,440 98	153,430 80	216,010 18	35,855 36	180,154 82
Water-rights and land to extend dam at Great Falls	45,000 00	117 96	44,882 04	....	44,882 04
Completion and extension of dam at Great Falls	127,229 80	54,662 62	72,567 18	16,016 23	56,550 95
Aggregate	1,350,186 06	734,875 25	615,310 81	129,704 72	485,606 09

*Made up as follows:

Available July 1, 1884	$21,802 95
Deficiency appropriation act of July 7, 1884	87,500 00
Deficiency appropriation act of March 3, 1885	87,500 00
	196,802 95

Abstracts of contracts for increasing the water supply of Washington, D. C., in force during the fiscal year ending June 30, 1885.

Contractors and addresses.	For—	Dated—	Expires—	Extended to—
Beckwith & Quackenbush, Mohawk, N. Y	Tunnel	Oct. 29, 1883	June 30, 1885	July 1, 1886.
Maloney & Gleason, Washington, D. C	Reservoir	Oct. 30, 1883	June 30, 1885	July 1, 1886.
Chittenden Brothers, Washington, D. C	Dam	Nov. 7, 1883	June 30, 1885	Nov. 1, 1885.
	do*	Mar. 4, 1884	June 30, 1885	Nov. 1, 1885.

* Supplemental contract to above.

REPORT OF CAPTAIN THOMAS W. SYMONS, CORPS OF ENGINEERS.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., July 30, 1885.

SIR: I have the honor to submit the following annual report of operations for the fiscal year ending June 30, 1885, * * * for increasing the water supply of Washington, D. C, of which, by your order, I am superintending engineer.

* * * * * * *

INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA.

The general plan which has been adopted for increasing the water supply of Washington consists:

(1) In building a masonry dam across Conn's Island and the Virginia Channel of the Potomac above the Great Falls, and raising the existing dam across the Maryland Channel to the reference height of 148 feet above mean high tide at the navy-yard, which will be the height of the entire dam.

(2) Connecting the present distributing reservoir with the new reservoir, to be constructed near Howard University, by a tunnel driven through the rock at an average depth of about 150 feet below the surface.

(3) Constructing a reservoir north of the city, near Howard University, capable of holding about 300,000,000 gallons.

(4) Connecting the new reservoir with the present existing system of water distribution, by means of large iron mains.

(5) In connection with this work for increasing the water supply provision is made for the erection of fish-ways at the Great Falls and at the dam, the construction of which devolves upon this office.

The operations on these different works will be considered in detail.

THE GREAT FALLS DAM.

In my last annual report a map was given showing the location of the dam and a general outline of it. The general terms of the supplemental contract entered into with the contractors, Chittenden Brothers, are also given.

The condition of the work at the commencement of the fiscal year, July 1, 1884, was as follows:

In the Virginia Channel the riprap backing had been extended out from the Virginia shore about 350 feet, and from Conn's Island about 100 feet, more than 500 cords having been used.

The riprap dam is about 10 feet wide at the water-level. On Conn's Island the dam was about one-third completed, and the excavation for the remainder nearly done, and stone enough at the site to complete it.

The last estimate for the preceding fiscal year shows the following amount of work and material to have been expended in the work:

9,500 square yards clearing, at 5 cents	$475 00
448 cords riprap, at $7.25	3,248 00
3,855 cubic yards excavation on Conn's Island, at $1	3,855 00
278 cubic yards excavation on Virginia shore, at $1	278 00
432 cubic yards concrete, at $5.50	2,376 00
214 cubic yards cut-stone and masonry, at $20.75	4,440 50
69 cubic yards coping stone, at $24.50	1,690 50
	16,363 00
Work under supplementary contract	7,000 00
	23,363 00

Ten per cent. is retained, according to the terms of the contract.

Work was carried on from the 1st of July until the middle of December by the contractors, when the high water and inclement weather caused its suspension. During this period the portion of the dam across Conn's Island was virtually finished and the riprap coffer-dam and frame coffer-dam below the line of masonry dam from Island Rock to the Virginia Channel completed. The construction of the masonry dam was carried out from the Virginia shore and from Island Rock, and it was hoped that at least this portion across the main channel of the river would be completed before winter. The contractors were constantly urged to greater exertions and better progress demanded, but they found it impossible to finish the main Channel work before they were compelled to cease operations for the winter. In consequence there was a gap in the masonry dam in the deepest part of the Virginia channel of 165 feet. It was feared that much damage would result to the ends of the dam from the floods, &c., of winter and spring, but fortunately the damage was very slight. The riprap dam at the gap was washed in and the down-stream frame coffer-dam was destroyed, but the cemented masonry dam stood unscathed.

From the middle of December, 1884, until March 16, 1885, no work was done beyond caring for plant, &c. On the latter date work was resumed, repairing the winter's damages and making preparations for resuming operations on the dam. Work was continued until June 30, 1885, upon which day the last stone was laid, completing the masonry dam across the main or Virginia channel of the river.

Many difficulties were met with in doing this work, the chief one arising from depending on the riprap up stream dam to keep out water. It seemed impossible to put in enough fine stone and clay on the up-stream side of this dam to keep out the water, and much time was lost in consequence. The contractors also suffered from the inadequacy and poor quality of their pumping plant. It was found to be an impossibility to get the bottom dry in the deepest holes in mid-channel with the method in use by the contractors, so they were permitted, after cleaning the bottom of all loose material, to put in a foundation of rich concrete, made of one part cement, one part sand, and three parts broken stone.

The work remaining to be done is the completion of the dam between Conn's Island and Island Rock, and putting the coping on the old dam to bring it up to the height of 148 feet above mean high tide.

The contract with Chittenden Brothers expired on June 30, 1885, but it has been extended until November 1, 1885.

All the work completed so far has been done in a most thorough and satisfactory manner, and reflects credit on the contractors and their assistants, and the inspectors representing the Government.

Daily reports of operations on the dam are received at this office.

The last estimate for the fiscal year ending June 30, 1885, shows the following amount of labor and material to have been expended on the work:

503 cubic yards coping masonry, at $24.50	$12,323 50
1,474 cubic yards cut-stone masonry, at $20.75	30,585 50
2,360 cubic yards concrete masonry, at $5.50	12,980 00
15 cords riprap backing, at $7.25—Conn's Island	108 75
510 cords riprap backing, at $7.25—Virginia Channel	3,697 50
11,368 pounds wrought-iron drift-bolts and cramps, at 7 cents	795 76
4,671 cubic yards excavation, at $1—Conn's Island	4,671 00
1,024 cubic yards excavation, at $1—Virginia Channel	1,024 00
9,500 square yards cleaning area, at 5 cents	475 00
Extra materials and labor as follows:	
224 cubic yards concrete masonry, at 50 cents	112 00
40 barrels Portland cement, at $2.70	108 00
	66,881 01
For making deflecting dams, coffer-dams, sluices, and all other auxiliary works required, as per supplemental contract	15,000 00
	81,881 01

Ten per cent. is retained according to the terms of the contract.

The amount appropriated for the dam is $145,151. The amount expended and due the contractors up to June 30, 1885, is $88,600.05, leaving an available amount of $56,550.95 to complete the work and do everything necessary to derive the greatest possible benefit from it when completed.

Mr. C. Orris Swann is the engineer and inspector in personal charge of the construction of the dam.

WATER RIGHTS AND LAND FOR DAM AT GREAT FALLS.

Amount appropriated	$45,000 00
Amount expended for surveys, &c	117 96
Leaving an available amount of	44,882 04

It is not known that any claims have been made for the land and water rights above referred to.

General B. F. Butler, as president of the Great Falls Manufacturing Company, during May of this year attempted to get an injunction from the United States Court at Baltimore to restrain all further work on the dam, and compel the removal of what had been done.

In this he was unsuccessful, the injunction being denied.

THE CONNECTING TUNNEL.

At the close of the fiscal year ending June 30, 1884, the Champlain avenue, Rock Creek, Foundry Branch, and west connecting shafts were completed in excavation. The east connecting shaft was still uncompleted. The total length of tunnel excavated was 1,591 feet.

At the close of the last fiscal year ending June 30, 1885, all the shafts were completed in excavation, the east and west connecting shafts were lined with masonry, 744.66 feet of tunnel was lined with masonry, the three air shafts were completed, and 13,498 feet of tunnel had been excavated.

The terms of the contract with Messrs. Beckwith and Qnackenbush required that the work should be completed by June 30, 1885. It is, however, far from being completed, and, viewed by the terms of the contract, the progress has been very slow and unsatisfactory, and the people of Washington will not be enabled for a long time to derive the benefits which will accrue to them upon the completion of this great work. Viewed by the light of experience, on the contrary, the progress has been satisfactory. The contractors are men of great experience who recognize the importance of completing the work at the earliest date possible, not only for the benefit of Washington, but for their own pecuniary benefit. The work has been pushed throughout with the greatest possible energy and vigor; every method suggested which might tend to expedite the work, and every appliance known to practical engineering which gave promise of better results, were cheerfully tried. To no fault of the contractors, but to the inherent and largely unforeseen difficulties of the work, must the delay in the completion of the tunnel be laid. The contract for the completion of the work was extended at the request of the contractors until June 30, 1886.

The accompanying longitudinal section of the tunnel shows the monthly progress and other information in regard to it. The rock of the western portion of the line is of much better quality than that of the eastern, and much less lining will be required. From this plat it is seen that the longest section of the tunnel yet to be driven is between the heading from the east shaft and the east heading from Champlain Avenue shaft. This distance is just about 1 mile (5,286.4 feet), and by an ufortunate coincidence it is in these headings that the greatest difficulties are met with and the slowest progress made. For several months the heading from the East shaft has been in rock of the most dangerous and treacherous character, in which the greatest care had to be taken to prevent accidents. This has been taken out to the large size required for lining, and in many places timbering has been put in. Progress is in consequence slow. The exact reverse is the case in the east heading from Champlain Avenue shaft. In this the rock has for months been of extreme hardness, the most difficult to drill that has been met with on the line. It often takes forty-eight hours' constant drilling to put in a set of holes, which may then require to be blasted two or three times before the rock is dislodged. Four drills are constantly in use in this heading.

In these headings the contractors have put their best men and appliances and have endeavored to secure the greatest possible progress even at the expense of the work at other places.

The same methods of work have been generally in use as described in my last annual report. The compressed air furnished from the central plant has, as a general thing, been such as to give a good working pressure of from 40 to 60 pounds at the drills. During the late winter and early spring, however, the proper pressure could not be maintained, owing to excessive leakage and the formation of ice in the transmission pipes. These pipes laid along or just under the surface of the ground expanded and contracted by the variations of temperature, and serious leaks resulted. The frozen ground prevented access to these leaks for some time, during which the work suffered delay; all damages were repaired as early as practicable.

It was not found practicable to run the pumps with the compressed air on account of its freezing tendency.

The ventilation of the drifts has been secured by means of wooden box casings or sheet-iron pipes carried in as closely as possible to the headings, and extended up the shaft and above head houses. A jet of air from the pipes conveying the compressed air tends to create a current which is further secured by the exhaust steam from the pumps being thrown into the ventilator in the shaft.

For lighting purposes in the headings cotton-seed and coal oil are principally used.

Where the work of lining is going on gas is used, which is furnished by the regular ty gas company. It gives very satisfactory light.

The explosives used have been Atlantic Giant Powder No. 1, No. 2 extra, and No. the quality of the rock deciding which particular explosive it is best to use.

During January the experiment was tried of putting a blacksmith shop in the rift just at the bottom of Champlain Avenue shaft, in order, if possible, to prevent he necessity of transporting drills up and down the shaft for sharpening. It did not rove satisfactory, however, and was soon removed to the surface.

Mules are at work for hauling material in the Rock Creek and Foundry Branch rifts and on the dumps.

A large amount of rock has been hauled from Rock Creek shaft for use on the new eservoir, and smaller amount from Champlain Avenue and Foundry Branch shafts.

The rock used in the construction of the overflow weir at the receiving reservoir was hauled from Foundry Branch shaft. A large amount of the material from the Champlain Avenue headings has been used by the District government for road work.

Mr. George H. Coryell was appointed on October 15, 1884, assistant engineer in charge of the tunnel operations, and has rendered very valuable services in this capacity. Immediately upon taking charge he instituted and carried out a complete resurvey of the tunnel, in order to insure the accuracy of the work and the meeting of the long tunnel drifts. Grades were established and the lines and grades given to the contractors, who were after this held responsible for properly keeping them. This necessitated the employment by the contractors of an instrument-man. The plan has worked well, doing away with the curse of a divided responsibility.

Recognizing the lasting importance of this work and the difficulty of repairs being made after completion, the contractors have been held to the strictest requirements of the contract in the masonry and lining of the tunnel and shafts. In this they have willingly acquiesced.

The rock passed through has been very varied in its nature. In the western portion of the line it has generally been good hard gneiss of such a nature that no lining can possibly be required. Occasional soft streaks are met with, and wide belts of rock rendered blocky and treacherous by clayey seams. On the east end of the line the rock becomes more micaceous and schistose in character, and bears large quantities of iron pyrites. Upon exposure to the air and moisture it is found that these rocks disintegrate with more or less rapidity. Some of the rock, which is blue and fairly hard when first mined, turns on exposure into a perfect mottled clay.

A careful study of the rock passed through is made, and, wherever it is deemed necessary, lining of rock and concrete is designed to be put in. A much larger portion of the tunnel will require lining than was at first anticipated. This is specified more definitely further on.

The amount of water met with in the tunnel so far is very little. There is some in every heading, however, but the amount is not sufficient to delay the work in any appreciable manner.

The following is a brief outline of the history of each shaft and heading in order, beginning at the eastern end and proceeding westward:

East reservoir shaft.—Excavation commenced January 2, 1884; completed July 17, 1884.

Lining commenced December 19, 1884; completed May 6, 1885.
Depth of shaft, 151 feet.
Diameter completed shaft, 14 feet.
Earth excavated, 1,666 cubic yards.
Rock excavated, 488 cubic yards.
Cost of excavation, $14,876; cost of lining, $7,625.50.

A description of the material passed through in sinking this shaft can be found in my last annual report.

The lining is carried up to within 2 feet of the ultimate bottom of the reservoir.

West heading, east reservoir shaft.—Heading commenced July 18, 1884; heading driven during year, 1,413 feet. Average monthly progress, 122.8 feet; average daily progress, 4.76 feet.

Length timbered, 378 feet.
Length excavated for lining, 766 feet.
Lining commenced March 7, 1885; completed to end of fiscal year, 290 feet.
Excavation in tunnel, 5,674 cubic yards.
Cost of excavation in tunnel, $45,416; lining in heading, $7,495.
Length to be driven to air-shaft, 2,041 feet.

The rock in the heading has varied greatly and has been very poor generally. It has been intersected at intervals with seams of talc and feldspar, making numerous seams and joints cutting the mass into detached blocks having little or no cohesion with one another.

Thirteenth Street air-shaft.—Commenced December 10, 1884; completed December 16, 1884.

Depth, 133 feet; lined with 5⅝-inch wrought-iron pipe one quarter inch thick.

Cost of air shaft, $1,995.

Champlain Avenue shaft.—Excavation commenced December 13, 1883; completed May 22, 1884.

Depth of shaft, 137.3 feet.

Earth excavated, 214.75 cubic yards.

Rock excavated, 528 cubic yards.

Cost of excavating, $6,568.50.

Champlain Avenue shaft, east heading.—Heading commenced May 22, 1884. Heading driven to June 30, 1884, 113 feet. Completed during the past fiscal year, 1, feet. Making total length 1,600 feet.

Average monthly progress, 124 feet; average daily progress, 4.78 feet.

Length timbered, none; length excavated for lining, none.

Excavation in tunnel, 4,563 cubic yards. Cost, $36,504.

Length to be driven to air-shaft, 1,604 feet.

For about 600 feet the rock in this heading is of a slaty structure with the laminations nearly perpendicular to the axis of the tunnel. This rock disintegrates on exposure. The remainder of the distance the rock is a very hard gneiss, with occasional veins of quartz from 2 to 6 feet in thickness.

Champlain Avenue shaft, west heading.—Heading commenced. Heading driven to June 30, 1884, 91 feet; driven during past fiscal year, 1,401 feet, making total length 1,495 feet.

Average monthly progress, 117 feet; average daily progress, 4.5 feet.

Length timbered, 279 feet; length excavated for lining, 1,137 feet.

Lining commenced March 17, 1885; completed to end fiscal year, 403 feet.

Excavation in heading, 6,146 cubic yards. Slips, 135 cubic yards. Cost, $49,370.

Cost of lining in heading, $10,119.50.

Length to be driven to air-shaft, 1,096.1 feet.

The rock in this heading is mostly mica schist, much of which disintegrates rapidly on exposure to the air and moisture.

Widow's Mite air-shaft.—Commenced October 24, 1884. Completed November 1884.

Depth, 154 feet. Lined with 5⅝-inch wrought-iron pipe one-quarter-inch thick. Cost of air-shaft, $2,310.

Rock Creek shaft.—Excavation commenced December 13, 1883; completed January 29, 1884.

Depth of shaft, 58.6 feet.

Earth excavated, 74 cubic yards.

Rock excavated, 167 cubic yards.

Cost of excavation, $2,114.

East heading.—Commenced January 29, 1884. Heading driven to June 30, 1884, feet; heading driven during past fiscal year, 1,857 feet, making total length feet.

Average monthly progress, 154.75 feet; average daily progress, 5.95 feet.

Length timbered 11, feet.

Length excavated for lining, 50 feet.

Excavation in heading, 6,357 cubic yards. Cost, $50,856.

Length to be driven to air-shaft, 321 feet.

The rock in this heading is generally good, varying from gneiss to mica schist. Considerable ground already gone through will require enlargement and lining.

West heading.—Commenced January 29, 1884. Heading driven to June 30, 1884, feet; heading driven during past fiscal year, 2,062 feet, making total length 2,529 feet.

Average monthly progress, 171.8 feet; average daily progress, 6.64 feet.

Length timbered, 48 feet.

Length excavated for lining, 80 feet.

Excavation in heading, 7,440 cubic yards. Slips, 124 cubic yards. Cost, $59,706.

Length to be driven to air-shaft, 810 feet. The rock is gneiss with occasional streaks.

Fayette Street air-shaft.—Commenced September 12, 1884; completed October 15, 1884.

Depth, 157 feet. Lined with 6-inch wrought-iron pipes one-quarter inch thick.

Cost of air-shaft, $2,355.

Foundry Branch shaft.—Excavation commenced December 12, 1883; completed February 16, 1884.

Depth of shaft, 69 feet.

Earth excavated, 92 cubic yards.

Rock excavated, 243 cubic yards.

Cost of excavation, $2,982.

East heading.—Commenced February 16, 1884. Heading driven to June 30, 1884, 313 feet; driven during past fiscal year, 1,652 feet, making total length 1,965 feet.

Average monthly progress, 137.66 feet; average daily progress, 5.3 feet.

Length timbered, none.

Length excavated for lining, none.

Excavation in heading, 5,604 cubic yards. Slips, 38 cubic yards. Cost, $44,889.

Length to be driven to air-shaft, 1,133.5 feet.

The rock in this heading is of very good quality, generally being hard gneiss with occasional veins and belts of mica schist.

West heading.—Commenced February 16, 1884. Heading driven to June 30, 1884, 280 feet; driven during past fiscal year, 1,778 feet, making total length 2,058 feet.

Average monthly progress, 148.16 feet; average daily progress, 5.71 feet.

Length timbered, none.

Length excavated for lining, 39 feet.

Excavation in heading, 5,915 cubic yards. Cost, $47,310.

Length to be driven to connect with west shaft, 151.8 feet. Most of the rock passed through is an excellent quality of gneiss. There is, however, considerable rotten rock where lining will be necessary.

West connecting shaft.—Excavation commenced February 12, 1884; completed June 23, 1884.

Lining commenced January 1885; completed April 2, 1885.

Depth of shaft, 97 feet.

Diameter completed shaft, 14 feet.

Earth excavated, 102 cubic yards.

Rock excavated, 1,250 cubic yards.

Cost of excavation, $13,112.

Cost of lining, $4,593.50.

This shaft was sunk nearly all the way through rotten gneiss, requiring timbering. The lining is not completed on top, which will be in the form of a dome.

East heading.—Commenced June 23, 1884. Driven to June 30, 1884, 13 feet; driven during past fiscal year, 196 feet, making total length 209 feet.

Average monthly progress, 31 feet; average daily progress, 1.18 feet.

Length timbered, 51.66 feet.

Length excavated for lining, 51.66 feet.

Excavation in heading, 808 cubic yards. Cost, $6,464.

Lining in heading commenced December 17, 1884. Completed to end of fiscal year, 51.66 feet. Cost, $1,453.16.

This heading was driven entirely by hand power; it is all through rotton gneiss and will have to be lined.

The object in driving this heading was to allow the shaft to be lined and to be far enough away to suffer no ill effects from the blasts when the heading from Foundry Branch is completed.

WEST CONNECTION.

A sketch is herewith showing the plan approved by you for making the connection between the distributing reservoir and the tunnel. The connection is by means of a 9-foot conduit, the bottom of which leaves the reservoir at an elevation of 135 feet above high tide and has a fall of 1 foot per 100 to the west shaft.

This conduit is constructed of brick and concrete, one ring of brick surrounded by 12 inches of concrete.

Provision is made for shutting the water of the reservoir from the tunnel by double lines of stop planks, and for thoroughly screening the water before it enters the tunnel.

Provision is also made for connecting the tunnel with the 7-foot conduit which passes around the distributing reservoir.

This will enable the tunnel to be supplied either from the reservoir or 7-foot conduit without in any way interfering with the present distribution system. It is proposed to shelter the arrangements for the control of the water at the reservoir beneath a plain and sightly arch-way.

Work on this West connection was commenced June 1, 1885, by removing the débris excavated from this shaft and with it dressing up the slopes of the reservoir embankment, making stone water-ways, &c. The excavation of the trench for the 9-foot connecting conduit was also commenced during June.

CASUALTIES.

During the progress of the work at Champlain Avenue shaft two employés were killed instantly; the foreman of the west drift, by the falling of a rock in the tunnel; the other employé, by falling from the top to the bottom of the shaft. Another employé was caught under the cage, and so injured internally that he died in the hospital. Time-keeper Clark Creighton was caught under the cage in Rock Creek shaft and crushed to the ground. He was injured internally, and died a few days afterwards. One other man was killed during the sinking of the Champlain Avenue shaft by its caving in.

This small number of casualties is an evidence of the great care and foresight shown by the contractors in looking out for the safety of the men employed. The number of serious accidents is remarkably small when the extremely dangerous nature of the operations is considered. In the work so far about 150,000 pounds of dynamite have been used without accident.

MONUMENT STONES.

Monument stones in size 8 inches by 8 inches by 3½ feet, marked "W. A. E.," and numbered from 1 to 55, are placed on the surface to indicate line of tunnel from west shaft to new reservoir. They are also placed at the corners of all the reservations for shafts.

In concluding this portion of my report I cannot but bear testimony to the extremely valuable services rendered by Mr. George H. Coryell, who has been in personal charge of the tunnel operations. In all the difficult, dangerous, and disagreeable operations connected with the work he has been most indefatigable, conscientious, and painstaking, and has shown throughout the highest intelligence and judgment.

I also take pleasure in testifying my appreciation of the service rendered by Mr. J. G. Holcombe, general assistant in the tunnel surveys, &c., and Messrs. C. B. Tarbell and H. M. Woodward, inspectors.

FINANCES OF THE TUNNEL.

The amount of money appropriated by the act of July 15, 1882, for the extension of the Aqueduct is $599,534.55.

This appropriation was made before the complete and finally adopted plan was decided upon, and at a time when it was impossible to determine its actual cost.

The experience gained in the prosecution of the work so far proves most conclusively that the above amount is far from being sufficient for its completion.

When the contract was let to Beckwith & Quackenbush the following items were considered and their cost at contract prices is given.

Tunnel excavation, 64,000 cubic yards, at $8	$512,000
Earth excavation in shafts, 1,500 cubic yards, at $6	9,000
Rock excavation in shafts, 1,200 cubic yards, at $10	12,000
Brick masonry in shafts, 250 cubic yards, at $18	4,500
Concrete masonry in shafts, 660 cubic yards, at $5	3,300
Dry-stone packing in shafts, 400 cubic yards, at $2.50	1,000
Air-shafts, complete	6,300
Total	548,100

This left from the appropriation $51,434.55 for all the lining required, and for all other expenses incidental to the work and necessary to its final completion. Not one of these estimated items is found to be sufficient.

From the very commencement it has been found necessary to do more work and expend more money than was originally contemplated. The shafts had to be sunk deeper to get into good rock, necessitating increased expense for excavation and lining. A much greater length of tunnel than was expected is found to be in poor rock, necessitating greatly increased expense for excavation and lining. Some items which seem to have been originally unprovided for have had to be considered.

Based upon the knowledge now possessed, the following estimate is submitted of the cost of fully completing the tunnel and putting it in perfect condition for the conveyance of water from the distributing to the new reservoir.

This estimate, varying so greatly from the originally estimated cost of the work, seems to require full and detailed explanation.

The work is an important link in the water-supply system of the Capital, and should be built in the best and most enduring manner possible, due regard being had to economy. It should be borne in mind that, when once completed and filled with water, the tunnel is inaccessible for repairs, except at a great cost of time and money and terrible inconvenience to the thousands of people who will be dependent upon it. Any repairs in the tunnel after it is once brought into use will require all or a large part of its contained water to be pumped out, and as it will hold nearly 10,000,000 gallons, and will require three pumping stations, this in itself must be a work of magnitude and cost.

To me it would seem the part of wisdom to take no chances, or the fewest possible, of any accidents happening to interrupt the water supply through it.

In these following estimates I have made provision for a thoroughly good lining for all those portions of the tunnel where the rock exposed is of a bad or doubtful charoter, and where a careful study causes the belief that yet unexposed will be bad or oubtful.

There has been so far to June 30, 1885, 567.66 feet of tunnel where the rock is so ad that it has required to be timbered in passing through it. In some places the aterial is so soft that it can hardly be considered rock at all. In other cases it is arder, but cut up with soft wet seams running in various directions. In some cases lready rock of this nature has been loosened by gravity alone for 30 feet above the oof of the tunnel. This will all, of course, have to be lined with masonry. It is robable that in addition to that now timbered there will be enough more in those portions of the tunnel yet to be driven which will require timbering to make the total length requiring it 800 feet, and this is the length estimated for herein.

Where the rock is of this nature requiring timbering, the contractors are paid for the cross-section of excavation actually required for putting in the timbers—this cross-section averages 155.35 square feet, and the cost alone of excavating this per foot in length is nearly twice that of excavating the normal section of the tunnel 7½ feet by 11 feet equaling 82½ square feet.

Besides this portion of the tunnel requiring timbering and subsequent lining, there is a very large amount in rock which temporarily stands, but which will require lining of masonry to put it in a permanent and proper condition. A large part of this bad rock contains an excess of mica of a very unstable kind which decomposes on exposure to air and water and becomes soft like clay. This varies from that composed entirely of mica, and which rapidly turns to clay on exposure, to that in which the elements of gneiss or granite approach in quality and quantity the proper proportions to make enduring rock.

Other bad rock consists entirely of, or contains, an excess of impure talc (silicate of magnesia), which disintegrates on exposure.

Some of the rock bears large quantities of iron pyrites (sulphite of iron), which decomposes and causes the rock containing it to crumble to pieces.

Other rock is unfit to be left without lining on account of seams more or less open, which divide it into irregular blocks with little or no cohesion. These seams are generally filled with talcose material through which water percolates. Some of the rock disintegrates very rapidly on exposure, while in some the disintegration is very slow.

Careful examinations in the tunnel reveal the fact that besides the bad rock requiring timbering there are 6585.34 linear feet of tunnel excavated in rock of bad or doubtful character which will require to be lined with masonry if the tunnel is to be completed in a first-class manner.

For a great part of this distance there can be no possible question as to the necessity for lining. It must be done. The necessity is less marked in other portions, but it is a risk to leave them unlined.

This work is of too great importance and the consequence of accident and failure is too weighty to permit any risks to be run. In the following estimate I have made provision for lining all this 6585.34 feet, and in addition for lining 3507.66 feet, which will probably have to be lined in that portion of the tunnel yet to be driven.

This makes a length of 10,093 feet of tunnel in which the cross-section of excavation to be allowed the contractors is that actually occupied by the cemented masonry of the lining. This cross-section is 109.67 square feet, or about one-third greater than the normal cross-section.

In driving the headings where the rock is unquestionably bad the cross-section is made large for lining. When the rock is questionable the cross-section is made of the normal size, to be afterwards enlarged for lining if found necessary.

There have been so far 2,241 feet excavated large for lining.

Of the tunnel which has already been driven there are 6,345 feet in solid rock of the best quality, of the durability of which there can be no question. Of the remaining portion yet to be driven it is estimated that there are 3,477.8 feet of this same nature. This will make 9,822.8 feet of tunnel excavated to the normal section of 82.5 square feet as contemplated in the original project. A sketch is given herewith showing the cross-sections of the tunnel under the varying conditions above expressed.

The method of lining the tunnel is derived from the study of pre-existing works and is very similar to that adopted for the new New York Aqueduct tunnel. The small size of the tunnel and the necessity of keeping the work of excavation going on at the same time with the lining renders impracticable the use of concrete in large quantities for lining. Brick is therefore used entirely for the lining, except for trimming up the bottom. Timbering is always removed when the masonry lining is put in, unless the operation is deemed by the engineer in charge too perilous.

The dry-stone packing is a very variable quantity, depending on the breaking of the rock beyond the prescribed limits. As the tunnel will be subjected to great pressure from within, it is deemed of the first importance to fill the space between the masonry lining and the natural walls in the most solid manner possible, and careful attention is given to this portion of the work.

AIR-SHAFTS.

The three air-shafts have all been sunk. To complete them, their upper ends must be arranged so as to give proper vent to the escaping air, and at the same time be protected against anything getting into the shafts which would pollute the water or interfere with their efficiency as air-shafts.

The Thirteenth street shaft being in a handsome street should be ornamental in its top finish, the others may be very plain.

THE CONNECTING SHAFTS.

These shafts have cost much more than was expected when the contract was let, as the character of the work required them to be sunk deeper than was anticipated.

Thus the west connecting shaft was contemplated to be 40 feet deep, and it was sunk 97 feet.

These two shafts are now very nearly completed. The entire cost of each is given in this estimate with the amount required to complete.

THE WORKING SHAFTS.

The entire cost of the excavation of each of the three working shafts is given in the estimate, together with the expected cost of completing them. It will, of course, be necessary to fill these shafts up very solidly to sustain the great pressure of water from below and prevent its escape to the surface and to the strata overlying the tunnel. The plan proposed for completing these shafts contemplates their use—(1) For flushing the tunnel; (2) for quickly emptying the reservoirs if ever rendered necessary or desirable; (3) as permanent well-holes for the purpose of entering the tunnel in case it is desirable to examine it, and taking out débris and passing in men and materials, if it is found to need repairs; (4) to furnish water in large quantities, if ever needed, to supply large pumping stations or for other purposes.

The water in the distributing and new reservoirs will stand at the height of [illegible] feet above the ground surface at Foundry Branch shaft, 123 feet at Rock Creek shaft, and 24 feet at Champlain Avenue shaft.

It is easy to be seen that by a proper arrangement of pipes and valves the tunnel can be very effectually flushed at its three points of greatest depression.

In each of these shafts, therefore, there is provided a permanent cast-iron pipe-well with outlet valve on top, which valve is covered and guarded by a small but strong brick house. Whenever desired this valve can be removed and the pipe used as a shaft for reaching the tunnel. A sketch showing the general plan is given herewith.

For Foundry Branch and Champlain Avenue shafts 3-foot wells are proposed, and for Rock Creek shaft a 4-foot well.

The cost of completing each shaft is given herewith.

WEST CONNECTION.

The cost of making and completing the connection of the distributing reservoir and 7-foot conduit with the tunnel is approximately estimated at $9,272.60. The cost of all surveys, engineering, inspection, &c., to date, and their probable cost to the time of completion, is given, and concludes the estimate.

RE-ESTIMATED COST OF TUNNEL (EXTENSION OF AQUEDUCT).

Excavation of tunnel.

Excavation, 9,822.8 feet (normal section 7½ feet by 11 feet = 82½ square feet) = 30,014 cubic yards, at $8	$240,112 00
Excavation, 10,093 feet (for lining) section, = 109.67 square feet = 40,990 cubic yards, at $8	327,968 00
Excavation, 800 feet (for timbering and lining), section average 155.35 square feet = 4,603 cubic yards, at $8	36,824 00
Removal on account of slips, &c., 1,000 cubic yards, at $1.50	1,500 00
Total for excavation of tunnel	606,404 00

Lining tunnel.

Lining with brick masonry 10,893 feet:	
Brick-work, 13,447 cubic yards, at $14	$188,258 00
Concrete, 4,575 cubic yards, at $5	22,875 00
Dry stone packing, 25,163 cubic yards, at $2.50	62,907 50
Drain-pipes for weepers through walls, 5,446 feet, at 7 cents	381 22
Total for lining tunnel	274,421 72

Air-shafts.

Thirteenth Street air-shaft, 133 feet, at $15	$1,995 00
Widow's Mite air-shaft, 154 feet, at $15	2,310 00
Fayette Street air-shaft, 157 feet, at $15	2,355 00
Top finish Thirteenth street air-shaft	75 00
Top finish Widow's Mite	40 00
Top finish Fayette street	40 00
Total for air-shafts	6,815 00

East connecting shaft.

Excavation:	
Earth, 1,666 cubic yards, at $6	$9,996 00
Rock, 488 cubic yards, at $10	4,880 00
Lining:	
Brick-work, 236 cubic yards, at $18	4,248 00
Concrete, 370 cubic yards, at $5	1,850 00
Dry stone packing, 611 cubic yards, at $2.50	1,527 50
Permanent iron steps	57 50
Drain pipes for weepers	10 00
Total cost of East shaft	22,569 00

This is entirely finished.

West connecting shaft.

Excavation:	
Earth, 102 cubic yards, at $6	$612 00
Rock, 1,250 cubic yards, at $10	12,500 00
Lining:	
Brick-work, 147 cubic yards, at $18	2,646 00
Concrete, 230 cubic yards, at $5	1,150 00
Dry stone packing, 319 cubic yards, at $2.50	797 50
Permanent iron steps	35 40
Drain-pipe for weepers	3 00
The above has been accomplished.	
To complete the shaft there remains to be done:	
Excavation at bottom of shaft for water cushion, 22 cubic yards, at $10	220 00
Concrete lining for water cushions, 6 cubic yards, at $5	30 00
Construction of dome over shaft:	
Brick-work, 15 cubic yards, at $18	270 00
Concrete, 17 cubic yards, at $5	85 00
Iron ladder from mouth to steps	30 00
Iron casing and cover for dome man-hole	50 00
	18,428 90

Champlain Avenue shaft.

Excavation:	
Earth, 214¾ cubic yards, at $6	$1,288 50
Rock, 528 cubic yards, at $10	5,280 00
The above has been accomplished.	
To complete the shaft there remains to be done:	
Brick-work, 50 cubic yards, at $18	900 00
Concrete, 65 cubic yards, at $5	325 00
Filling, 675 cubic yards, at $1 (estimated price)	675 00
36-inch pipe with special castings	969 00
36-inch gate, for flushing, &c	800 00
Labor, lead, jute, &c., placing and calking pipes	340 00
Permanent brick shaft-house	500 00
Total cost Champlain Avenue shaft	11,077 50

Rock Creek shaft.

Excavation:	
Earth, 74 cubic yards, at $6	$444 00
Rock, 167 cubic yards, at $10	1,670 00

The above has been accomplished.

To complete the shaft there remains to be done:

Brick-work, 50 cubic yards, at $18	$900
Concrete, 65 cubic yards, at $5	325
Filling, 180 cubic yards, at $1 (estimated)	180
48-inch pipe, with special castings	825
48-inch gate, for flushing	1,700
Labor, lead, jute, &c., placing and calking pipe	390
Anchor bolts	200
Permanent brick shaft-house	750
Total cost Rock Creek shaft	7,385

Foundry Branch shaft.

Excavation:	
Earth, 92 cubic yards, at $6	$552
Rock, 243 cubic yards, at $10	2,430

The above has been accomplished.

To complete the shaft the following requires to be done:

Brick-work, 50 cubic yards, at $18	900 00
Concrete, 65 cubic yards, at $5	325 00
Filling, 261 cubic yards, at $1 (estimated)	261 00
36-inch pipe, with special castings, &c	594 00
36-inch gate for flushing tunnel	800 00
Labor, lead, jute, &c., placing and calking pipe	330 0
Anchor bolts	150 00
Permanent brick shaft-house	500 00
Total cost Foundry Branch shaft	6,842 00

West connection.

Total estimated cost of connecting the distributing reservoir and tunnel	$9,272

Miscellaneous expenditures.

There have been expended up to June 30, 1885, for purposes not included in the foregoing for all work of engineering, surveys, inspection tests, signals, office expenses, advertising, printing, instruments and repairs thereof, &c	$18,206 34
Estimated cost of the above to complete tunnel	12,000 00
	30,206 34

SUMMARY OF RE-ESTIMATED COST OF TUNNEL.

Tunnel excavation	$606,404 00
Tunnel lining	274,421 72
Air-shafts	6,815 00
East shaft	22,569 00
West shaft	18,428 90
Champlain Avenue shaft	11,077 50
Rock Creek shaft	7,385 00
Foundry Branch shaft	6,842 00
West connection	9,272 60
Engineering and miscellaneous	30,206 34
Total estimated cost of tunnel	993,422 06
Amount appropriated	599,534 55
Balance	393.887 51

I am aware that this is a very great discrepancy between the amount appropriated for the completion of the Aqueduct extension and the amount which it will actually cost. I have endeavored to explain how this comes about. The amount appropriated would have completed the tunnel under the most favorable possible conditions. Any deviation from these most favorable conditions would cause a deficiency, and these deviations have been very great. As I have said before, this estimate is for the completion of the Aqueduct extension in the most complete and thorough manner, the way that it is considered that a work of this nature and magnitude should be completed. Its cost can be very much reduced by neglecting to put masonry lining in certain stretches of the tunnel where the rock is of a doubtful nature, if it be deemed for the highest interests so to do.

The estimate is to a certain extent hypothetical, being based on what may be encountered in the tunnel headings yet to be driven. Developments in these may reduce the ultimate cost very much, but it is almost certain *they will not increase it.*

The estimate is ample under the most unfavorable conditions that are deemed possible can exist, to complete everything in the most perfect manner.

The total amount expended on the tunnel, including contractor's retained percentages due for work up to June 30, 1885, is $438,722.53, leaving a balance for further work of $160,812.02.

LAND FOR AQUEDUCT EXTENSION.

The amount appropriated for land for the Aqueduct extension by the act of July 15, 1882, was $51,370. Of this there has been expended to the end of the past fiscal year $14,151 15, leaving a balance available of $37,218.85.

The land paid for so far from this appropriation has been a portion of Foundry Branch shaft lot, the Rock Creek shaft lot, the Widow's Mite air-shaft lot, a portion of the Champlain Avenue shaft, and a subterranean right of way for a portion of the length of the tunnel.

The appropriation is in excess of the amount required.

MAIN CONNECTIONS.

At the beginning of the fiscal year July 1, 1884, nearly all the pipes for uniting the new reservoir with the city distribution had been received, the connection had been made at the crossing of New Jersey avenue and L street, about 3,000 feet of 48-inch had been laid, and the work of laying the remainder was in progress, under the immediate charge of Mr. E. C. Kirlin.

This work was continued without interruption until the crossing of Four-and-a-half and College streets was reached, where connection with the 75-inch pipe was to be made.

In addition to the laying of the 48-inch main the stop-valves and all auxiliary branches were set at street crossings, and a valve-chamber and man-hole built for each stop.

There was also 564 feet of 12-inch pipe laid on Boundary street west from the main line.

The foundations having previously been prepared, the castings, gate, &c., for the connection between the 75-inch and 48-inch pipe were placed in position and the connection made.

Mr. Kirlin was then transferred to another portion of the work, and Mr. John F. Palmer placed in charge.

A large valve-chamber, shown on map in last annual report was then constructed, together with the entrance to it, which consists of a brick arched passage and winding stair-way. This was completed to the surface on October 4. The valve-chamber is built entirely of concrete, about 450 cubic yards having been used in it and its auxiliaries.

The remaining work of the main connections consisted in laying the 75-inch pipes from the valve-chamber to the new reservoir. This could only be done in connection with the construction of the west side conduit when the trench was excavated by the reservoir contractors.

This was by far the most difficult part of the whole work of the main connections, owing to the great depth of the trench, it being from 30 to 52 feet, averaging 39 feet deep, and the very heavy pipes weighing each about 20,000 pounds.

The best method of handling these heavy pipes in the deep trench was a matter for great consideration. The plan finally decided upon and which worked very well was to bottom out the trench for about 65 feet and put in the concrete bottom.

Short inclines, about 1 on 2, were then cut at right angles to the line of trench, and down these the pipes were parbuckled until the top of the vertical cut 18 feet deep was reached. The pipes were lowered this 18 feet by inclines in the trench itself. Once in the bottom they were handled and put in position by 10-ton differential pulley-blocks. When in permanent position they were encased in concrete to at least a thickness of 12 inches, and the west side conduit built on top of them.

The laying of this pipe was nearly completed at the close of the fiscal year.

None of the pipe has been calked. As the calking is to be driven cold from the inside, and can be done at any time, it has been deemed best to leave it until everything becomes fully settled in place, and until the currents of air causing expansion and contraction can be largely excluded.

Notwithstanding the dangerous and difficult nature of the work of laying this heavy pipe, no accident of any kind has occurred, and Mr. Palmer deserves the highest credit for the skill and patience displayed.

The brick head-house for the valve-chamber was completed during the present summer.

FINANCES OF THE MAIN CONNECTIONS.

The appropriation for the work of making the main connections was....	$165,400 00
Of this amount there has been expended, including liabilities, to June 30, 1885	162,406 12
Leaving a balance of	2,993 88

This balance will be required to purchase the lead needed for the work and to pay for calking the 75-inch pipe-line. It is believed that the amount will be just about sufficient for the purpose.

* * * * * * *

THE NEW RESERVOIR.

At the beginning of the last fiscal year, July 1, 1884, work had been commenced on all parts of the reservoir, and the following had been accomplished by the contractors:

142,521 cubic yards earth excavation, at 30 cents	$42,756 30
4,644 cubic yards puddling, at 40 cents	1,857 60
1,492 cubic yards concrete, at $5.50	8,206 00
66 cubic yards brick masonry, at $9	594 00
428 square yards trap-rock lining, at $1	428 00
1,688 square yards paving, at 28 cents	472 64
Total	54,314 54

The contractors had on hand quite a quantity of plant suitable for carrying on the work.

From July 1 the work was carried on in all parts of the reservoir, until December 20, when the inclement weather compelled the suspension of all earthwork upon the dam.

At the close of the working season of 1884 the main body of the dam and the puddle core had been raised to 131 feet above the plane of reference, and 37 feet above its lowest point, the old bed of the creek. The paving of the eastern side of the reservoir had been completed for 740 feet. The east flood-channel had been excavated and paved from the north end of the closed conduit to the arched bridge in the Soldier's Home, a distance of 2,374 feet. This east closed conduit and its head walls were finished.

The west closed conduit had been built from the creek to the intersection of Four-and-a-half and College streets, a distance of 670 feet.

From December 20, 1884, until April 10, 1885, the construction of the dam was suspended. During this period a small force was employed in distributing stone for paving the interior slopes of the reservoir, in excavating the trench for the 75-inch pipe, lowering the pipe into position, inclosing it in concrete, and constructing the west side 6-inch by 9-inch conduit in the pipe trench.

Except in extreme cold or stormy weather this work progressed without interruption.

Notwithstanding the low temperature, by the judicious use of quick-setting cement the concrete and brick masonry constructed is in hardness, strength, and tenacity entirely satisfactory.

Progress upon this pipe trench and west conduit has been necessarily slow, owing to its great depth (averaging 39 feet), and the time required to brace up the sides to prevent slipping.

The change in the method of draining the reservoir by the 12-inch pipe laid through the dam in April, 1884, in consequence of which we were enabled to reduce the depth of this trench more than 12 feet, and allowing a slight slope of the sides of the trench to within 18 feet of the grade, have been fully justified. It has permitted a far better construction of the dam than would otherwise have been possible, and the work on it has not been seriously interrupted by storms. It also very materially cheapened and facilitated the lowering and placing of the 10-ton pipes. Men were enabled to work in this deep trench without fear of life or limb, and in consequence the quality of the concrete and brick masonry is undoubtedly better.

Work was resumed about the 10th of April, and has been steadily pushed ever since; everything has been worked to better advantage than in 1884, and especially is this true of the steam excavator, from which the out-put has averaged about 446 cubic yards against 326 in 1884, although the "lead" has been twice as long.

The contractors have upon the ground the following working plant. In addition a large force of animals and wagons are hired as the work requires: One steam excavator, 2 locomotives, 53 cars, 1¾ miles steel track, 29 two-horse four-wheeled excavators, 8 wagons, 40 carts, 35 two-horse scrapers, 140 wheelbarrows, 1 steam derrick, 1 steam stone-crusher, 2 disk earth pulverizers, 1 harrow, 5 heavy ground rollers, 4 water-carts, blacksmith and wagon shops, with tools, and the necessary hand tools for the proper conduct of the work.

The condition of the new reservoir at the close of the fiscal year ending June 30, 1885, is generally as follows: The body of the dam and puddle core has been raised to a height of 142 feet above the plane of reference, or 48 feet above the creek bottom; the east flood channel, east closed conduit, and open flood channel below the dam have been completed; the interior slopes of the east side have been graded and paved for a length of 2,231 feet; 1,177 linear feet of the west side closed conduit has been constructed, and 499¾ feet of the 75-inch pipe have been laid and inclosed in concrete.

The contract for the construction of the reservoir expired June 30, 1885, but the work was far from being completed.

As the reservoir can be of no use until the tunnel is completed, it has not been deemed necessary to hurry up this work, and an extension of time to June 30, 1886, has been granted the contractors.

The quality of the work performed has been the very best, and is believed to be beyond criticism. The work upon the body of the dam has been most thoroughly done from the foundation upwards: it is built of most excellent clayey materials, kept wet and thoroughly rolled in horizontal layers, and will prove as impermeable to water as the puddle core itself. Upon the opening of the present working season, it was noticeable that the north slope of the dam had not suffered so much from frosts and rains as had the natural hillsides of the same materials. The puddle core is a solid mass of the finest quality of clayey earth, compacted by rolling in thin layers and kept sufficiently wet to bond the layers thoroughly together. Levels taken upon the dam at the close of the working season of 1884, and again upon the resumption of work in April, 1885, failed to show that the slightest subsidence had taken place during the winter.

The paving on the east slope of the reservoir, despite the rough, irregular stone used, is a splendid example of solidity, true lines, and surfaces.

Every required condition is filled in the work upon the conduits, and the concrete construction is especially commendable. All cement used is doubly tested, at the reservoir roughly, and at the Aqueduct office more delicately.

The contractors deserve special credit for their honest endeavors to do good work and to carry out the wishes of those in charge, as do the inspectors for their great care, judgment, and watchfulness in the direct oversight of the work.

I cannot speak too highly of the very valuable services rendered by Mr. John A. Partridge, who has from the beginning had direct personal charge. His sterling integrity and great experience in similar work enable the utmost confidence to be placed in the construction of the reservoir.

Mr. Partridge, in his report to me, says:

"I have been most cheerfully and ably assisted in the exacting engineering work upon the reservoir by Mr. John F. Alexander, and in the inspection of details of construction by Messrs. A. R. Potts, John L. Twenizer, T. J. Hackett, G. W. S. White, and H. C. Chadwell, who have all rendered faithful and earnest service in the work assigned to them."

The following exhibits the amount of work which has been accomplished by the contractors up to June 30, 1885:

RESERVOIR.

The total estimate of work done to June 30, 1885, is as follows:

495,296	cubic yards excavation, at 30 cents	$148,588 80
37,125	cubic yards puddling, at 40 cents	14,850 00
2½	cubic yards cut-stone masonry, at $15	37 50
312	cubic yards brick masonry, at $9	2,808 00
3,715	cubic yards concrete masonry, at $5.50	20,432 50
79	cubic yards rubble masonry, at $6	474 00
1,257	square yards trap-rock lining, at $1	1,257 00
3,116	cubic yards broken-stone lining, at $2	6,232 00
19,692	square yards paving, at 28 cents	5,513 76
228	linear feet cast-iron drains, at 75 cents	171 00
7,500	feet, B. M., pine plank, at $30 per M	225 00
Total		200,589 56
Less 10 per cent. retained		20,058 96
		180,530 60

This has been accomplished by:

	Days.
Common laborers	50, 099
Masons	567
Pavers	1, 145
Steam excavator	219
Locomotives	306
Cars	1, 820
Animals	32, 026
Four-wheeled excavators	4, 196
Wagons	2, 687
Carts	5, 004
Scrapers	2, 820
Wheelbarrows	5, 137

Number of loads of earth moved during the year ending June 30, 1885.

	Number of loads.	Average.
By cars	39, 359	22. 50+
By wheeled excavators	171, 286	46. 83+
By wagons	71, 504	41. 76+
By carts	120, 566	43. 26+
By horse scrapers	278, 307	109. 69+
By wheelbarrows	476, 905	151. 92+

CONSTRUCTION DETAILS.

Bottom of reservoir.—The bottom of the southern portion of the reservoir basin is in a very fine quality of impermeable mottled and blue clay many feet in thickness, which will not permit the passage of water either from or into the reservoir. This is not the case with the northern part. As the work of grading progressed it became evident that the bottom of that part of the reservoir lying north of a line crossing the basin about 150 feet south of the Government spring was free sand and gravel completely saturated with water. In several places springs developed to such an extent as to produce the effects of quicksand. By boring it was determined that the impermeable clay above mentioned dipped rapidly northward and the sands and gravel occupied the depressions in the clay to a depth of 15 to 30 feet.

The excavation of this wet sand and gravel would probably result in the destruction of the Government spring and involve the removal of a large amount of material of no value for purposes of construction, and with no adequate benefits resulting from its removal.

To avoid, if possible, disturbing the gravel stratum overlying the sand, and to procure better earth for the construction of the dam, it was resolved to raise the grade of the bottom of this portion of the reservoir about 12 to 15 feet.

To procure compensating water storage capacity and material for the dam, the northern boundary of the water-line was extended to add about 5 acres additional to the area of the reservoir. All of this gravel and sand which contains any traces of vegetable or organic matter will be entirely removed. To prevent leakage from or into the reservoir all this porous area should be covered with puddled clay to a depth of at least 2 feet.

At the foot of the eastern slope of the reservoir is found embedded in sandy clay a considerable deposit of carbonized wood and vegetable matter, largely impregnated with iron sulphate. This deposit extends over about 500 by 100 feet, and will be removed to a depth of about 2 feet and the space refilled with puddled clay.

In general all deposits of earth, muck, gravel, &c., which can by any possibility have an injurious effect on the water stored in the reservoir will be removed or entirely excluded from any contact or communication with the water.

Drainage of the reservoir.—The plan proposed for draining the reservoir, and in conformity with which all work so far has been done, provides iron pipes, thoroughly calked and embedded in concrete, to be placed on the bottom of the reservoir and designed to carry off the ordinary flow, sewage, &c., of the small streams entering the site near its northeasterly and northwesterly limits. The storm waters are to be carried around the edge of the reservoir in open flood channels, except where the depth of excavation renders closed conduits necessary, and be discharged into the natural stream bed below the dam.

The experiences of the past year with the open flood channels, and the fact that popular apprehension has been excited because of these drain-pipes being carried through and under the waters contained in the reservoir, point unerringly to the desirability of a change in the plans.

The change proposed is to do away entirely with the iron drains and to change the open flood channels into closed conduits to carry both the ordinary flow and sewage and the storm waters around the reservoir. Surface gutters with drops into these encircling conduits are provided for intercepting the immediate drainage of the hillsides sloping to the reservoir.

Detailed plans and estimates for this change were prepared, and on June 29, 1885, were submitted by you to the Chief of Engineers for his approval.

Another advantage in this change would be that of enabling a roadway to be built around the reservoir over the space now occupied by the flood channels, which would add an exceedingly attractive feature to the grounds.

Circulation of water.—As the water is to enter the reservoir from the tunnel and leave it by the 75-inch pipe at the same point, it early became necessary to consider some method of securing circulation in the large mass of stored water.

The plan proposed for accomplishing this is to take the water as it emerges from the tunnel and conduct it by means of culverts to the three most distant corners of the reservoir.

To return to the effluent gate-house the water will then have to traverse the entire length of the reservoir. By means of these culverts a most perfect circulation will be assured. As timber constantly wet is practically imperishable, and as there will be no strain upon them, it is proposed to build these culverts of wood, to be securely anchored against flotation. A main culvert, 8 by 10 feet in size and 500 feet long, may extend to the center of the reservoir and there branch into three, each 4½ by 6 feet in size, leading to the distant corners.

Paving, &c.—It was expected that the tunnel driven from the Reservoir shaft would supply a large part of the stone for paving and concrete, but up to the present time not over one-third of the rock excavated proves useful for such purposes, as it disintegrates by exposure to atmospheric changes. The supply of stone has mainly been derived from Rock Creek shaft, with some from Champlain avenue.

During the year 8,140 cubic yards have been delivered from Rock Creek and Foundry Branch shafts, and 2,852 from Champlain avenue shaft.

FINANCES OF THE RESERVOIR.

The amount appropriated for the construction of the new reservoir and erecting gate house, by the act of July 15, 1882, was $431,273.75.

In the contract let to Maloney & Gleason for the construction of the reservoir, the following items are specified, which, at their contract prices, brings the cost of those portions of the work covered by the contract to $298,980:

Excavation, 695,000 cubic yards, at 30 cents	$208,500
Puddling, 54,000 cubic yards, at 40 cents	21,600
Sodding, 20,000 square yards, at 20 cents	4,000
Cut-stone masonry, 12 cubic yards, at $15	180
Brick masonry, 250 cubic yards, at $9	2,250
Concrete masonry, 3,500 cubic yards, at $5.50	19,250
Rubble masonry, 100 cubic yards, at $6	600
Trap-rock lining in cement, 1,400 square yards, at $1	1,400
Broken stone lining, 8,000 cubic yards, at $2	16,000
Paving, 80,000 square yards, at 28 cents	22,400
Coping, 95 linear feet, at $5	475
Cast-iron drains, 3,100 linear feet, at 75 cents	2,325
Total	298,980

This leaves a sum of $131,293.75 for all contingencies, extra expenses, and the final completion of all details not specified in the contract.

The money appropriated is not sufficient to complete the reservoir in a proper manner, and a further sum will be required therefor.

The causes for this deficiency are many and obvious.

In the first place the uncertain and very varied nature of the material in which and of which the reservoir is built has caused and will cause far more work than was anticipated in order to make everything secure and perfect for the storage of water.

The work required on the reservoir bottom is a case in point.

A number of changes have been made in the plan and details of the reservoir, rendered necessary and desirable as the work developed itself. These changes have all been made in the interest of efficiency, safety, ultimate economy, and to save time. The method of draining the reservoir which has been adopted is a case in point. The plan of substituting encircling closed conduits for the open flood channels and iron drain-pipes, and which has been previously alluded to, is another.

The failure of the tunnel heading from the reservoir to supply any amount of good stone for paving, broken stone, concrete, &c., has entailed a very large expense for hauling stone from the other tunnel shafts.

In order to thoroughly secure the bottom and ends of the dam the amount of puddling was considerably increased. No chances whatever have been taken in the construction of this dam, the consequences of its failure are far too grave to permit of the slightest hesitation in doing work which safety seems to demand. The puddling in the bottom of the reservoir will fully double the amount estimated for under the contract.

There are also many items not provided for nor mentioned in the original contract which it is necessary to consider in making the final and complete estimate of the cost of the reservoir.

The principal items are, the provision for causing circulation of the water, the erection of the necessary gate-house; erection of keeper's house; construction of substantial and suitable fence about the reservoir; plowing, soiling, and seeding the grounds about the reservoir; providing for the continued existence and safety of the Government spring supplying the Capitol with water, and for engineering and superintendence.

The following estimate has been very carefully prepared, and shows the total cost of the construction of the reservoir, including what has been done and what remains to be done. It is divided into those items specified in the contract and those not included in the contract. These items are lettered, and where explanation is deemed necessary it follows the estimate.

This estimate is based upon the supposition that the plans recommended for a change in the method of drainage will be adopted.

Under contract.

	Completed.	Remaining.	Total.	Price.	Total cost.
A.—Earth excavation.............cubic yards..	495, 296	352, 318	847, 614	$0 30	$254, 284 20
B.—Puddling ....do....	37, 125	102, 013	139, 138	40	55, 655 20
C.—Sodding......................square yards..	....	20, 000	20, 000	20	4, 000 00
D.—Cut-stone masonry............cubic yards..	2. 5	9. 5	12	15 00	180 00
E.—Brick masonry ....do....	312	704	1. 016	9 00	9, 144 00
F.—Concrete masonry....................do....	3. 715	6, 121	9, 836	5 50	54, 098 00
G.—Rubble masonry.......................do....	79	97	176	6 00	1, 056 00
H.—Trap-rock lining.............square yards..	1, 257	3, 858	5, 115	1 00	5, 115 00
I.—Broken stone lining...........cubic yards..	3, 116	8, 859	11, 975	2 00	23, 950 00
K.—Paving.......................square yards..	19, 692	56, 675	76, 367	28	21, 382 76
L.—Coping ....linear feet..	....	87	87	15 00	1, 305 00
M.—Cast iron drain......................do....	228	200	428	75	321 00
					430, 491 16

Not specified in contract.

	Amount.	Price.	Cost.
N.—Pine plank for sheet-piling..........................feet B. M..	7, 500	$30 00	$225 00
O.—Pine timber, &c., in circulating conduits.....................do....	630, 400	25 00	15, 760 00
P.—Stone ballasts for circulating conduits ....cubic yards..	2, 800	75	2, 100 00
Q.—Wrought iron fence around reservoir.........................feet..	6, 780	4 00	27, 120 00
R.—Wire fence to protect dam and enclose keeper's house	11, 205	10	1, 120 50
S.—Gravel walk about reservoir for inspection, &c....cubic yards..	1, 000	2 00	2, 000 00
T.—Terra-cotta 12-inch drain-pipes...............................feet..	200	1 00	200 00
U.—12-inch cast-iron grates	2	5 00	10 00
V.—24-inch cast-iron grates..	14	8 00	112 00
W.—Acres ground, smoothed, soiled, and seeded..........................	25	300 00	7, 500 00
X.—Stone hauled to reservoir for paving, &c............cubic yards..	45, 500	90	40, 950 00
Y.—Trap-rock paving blocks...	50, 711	64 50	3, 270 87
Do	147, 000	48 00	7, 056 00
Z.—Man-hole-covers	18	8 50	153 00
A A.—Hauling trap-rock blocks to reservoir..............................	203, 211	80	1, 581 69
B B.—Gate tower for 12-inch drain-pipe and valve........................	....	....	460 00
C C.—Alteration of Government spring house..............................	....	....	1, 500 00
D D.—Reservoir keeper's house...	....	....	5, 000 00
E E.—Gate-house and gates...	....	....	35, 000 00
F F.—Iron water-pipe...tons..	35. 455	40 00	1, 418 20
G G.—12-inch valves and labor setting...................................	2	75 00	150 00
H H.—8-inch valves and labor setting....................................	1	50 00	50 00
Total	....	....	152, 737 26

There have been expended up to date:

For trial shaft in reservoir and exploring expenses	$11,634 72
For engineering, inspections, pay-rolls, making tests, &c	17,509 52
For other expenses, advertising, tearing down and removing houses, stationery, forage, terra-cotta pipe, survey stakes, instruments and repairs, boring and testing machinery, printing, lumber, hauling, water-pipes, fuel, car-tickets, &c	1,263 14
It is estimated that the expenses of engineering, superintendence, tests, &c., to complete the work will be	12,000 00
	42,407 38

SUMMARY.

Under contract	$430,491 16
Not specified in contract	152,737 26
Exploration, engineering, &c	42,407 38
Total cost	625,635 80
Appropriation	431,273 75
Deficiency	194,362 05

A.—In estimating the amount of excavation levels have been taken over the entire site of the work to determine what has to be done, and this, added to what has been done, gives the total amount necessary.

This gives an excess over the amount specified in the contract of 152,614 cubic yards.

This excess arises from various causes; nearly half of it from excavating in bottom of reservoir to replace with puddling; a large amount is for the removal of material taken from the shaft and tunnel and incorporated in the dam; other items are for excavating side slopes to be replaced with puddling, excavating gravel, sand, and muck, in beds of creeks and ravines, increased depth of puddle trench, for 6-inch Congressional spring-water pipe, and 12-inch drain-pipe under dam, mucking site of dam, and levees, &c.

B.—Excess of puddling over contract specified items 85,138 cubic yards. Of this 71,072 yards is for puddling in bottom of reservoir; the remainder is for necessary puddling on interior slope, and in the old creek bed, in pipe trench, &c.

E.—Excess in brick masonry 766 cubic yards. This is mainly on account of proposed substitution of closed conduits for open flood channels.

F.—Excess in concrete masonry 6,338 cubic yards. This is mainly on account of the substitution of closed conduits for open flood channels. It is also due to the quite large amount used in securing the passage of the Congressional spring pipe and 12-inch drain-pipe through the dam, and in various other places in small quantities.

G.—Excess of rubble masonry 76 cubic yards, rendered unnecessary by the change in plans proposed, and additional depth which it is considered expedient to give the head walls.

H.—Excess in trap-rock lining 3,715 square yards, due to proposed substitution of closed conduits for open flood channels.

I.—Excess in broken stone lining 3,045 cubic yards is believed to be due to greater area of paving with broken stone backing than was originally estimated.

K.—Diminution of paving 3,633 square yards due to substitution of closed conduit for west flood channel.

M.—Iron drains diminished 2,672 linear feet due to same cause.

N.—Sheet-piling used in eastern root of dam to economize excavation and puddling and more certainly insure safety.

Q.—The new reservoir is situated just on the borders of the city in a district quite thickly populated. It must be very carefully guarded and protected against anybody and anything that through carelessness, ignorance or viciousness, could pollute the contained waters. This protection must come largely from a fence, secure and indestructible, the necessity for which is much greater than it would be if the reservoir were in a less populous community. This fence should be very strong, high enough to prevent men or animals getting over it, and close and tight enough to keep dogs, hogs, and everything else of like nature out.

Furthermore the reservoir is going to be a very prominent feature of the landscape, being just on the borders of the Soldiers' Home and in the line with it and the Capitol; it will be brought closely and often under the inspection of nearly every resident of the city and every stranger visiting it. The fence, therefore, should be of such a nature as not to offend the eye while fulfilling all the other functions required of it.

It is believed that a strong, plain fence of wrought iron, properly constructed will best meet the requirements of the case and prove most satisfactory and economical in the end. This fence it is proposed to place near the outer edge of the levee surrounding the reservoir and near the interior crest of the dam.

R.—About the whole property pertaining to the reservoir should be built a strong and plain wire fence to thoroughly guard the slopes of the dam and sides.

W.—The reservoir completed will have the slopes of its sides and dam soiled and sodded. This item provides for plowing, smoothing into shape, sodding, and seeding all the remaining lands of the reservoir, including top of the dam and levees, &c.

X.—This is stone hauled from the other working shafts of the tunnel.

Y.—These are to be furnished for the work under the terms of the contract.

B.—B.—At the inner end of the 12-inch drain-pipe there must be a valve, very securely placed on account of the great head of water, and this item provides for the emplacement and means of reaching it from the surface.

C. C.—It will be necessary to close the Congressional spring house against the entrance of water from the reservoir and raise it above the surface of the water.

This item covers the necessary expense.

D. D.—This is a necessary expense not mentioned in the original specification and contract.

E. E.—The detailed plans for this gate-house have not been made and the cost can only be given approximately.

To thoroughly control the water of the tunnel, reservoir, and mains, the gate-house must be very strong, complicated, and expensive, and it is believed will cost fully the amount herein stated.

Out of the appropriation of $431,273.75 there has been expended to June 30, 1885, and due the contractors for retained percentage, $251,118.93 leaving for further work the sum of $180,154.82.

LAND FOR RESERVOIR.

The total amounts appropriated for land for the reservoir is $210,250, as follows:

By act of July 15, 1882	$35,250 00
By act of July 7, 1884	87,500 00
By act of March 3, 1885	87,500 00
	210,250 00
On this there has been paid for land and expenses appertaining to its acquisition the sum of	207,256 47
Leaving an available amount of	2,993 53

As far as known this will be sufficient to satisfy all remaining claims.

Very respectfully, your obedient servant.

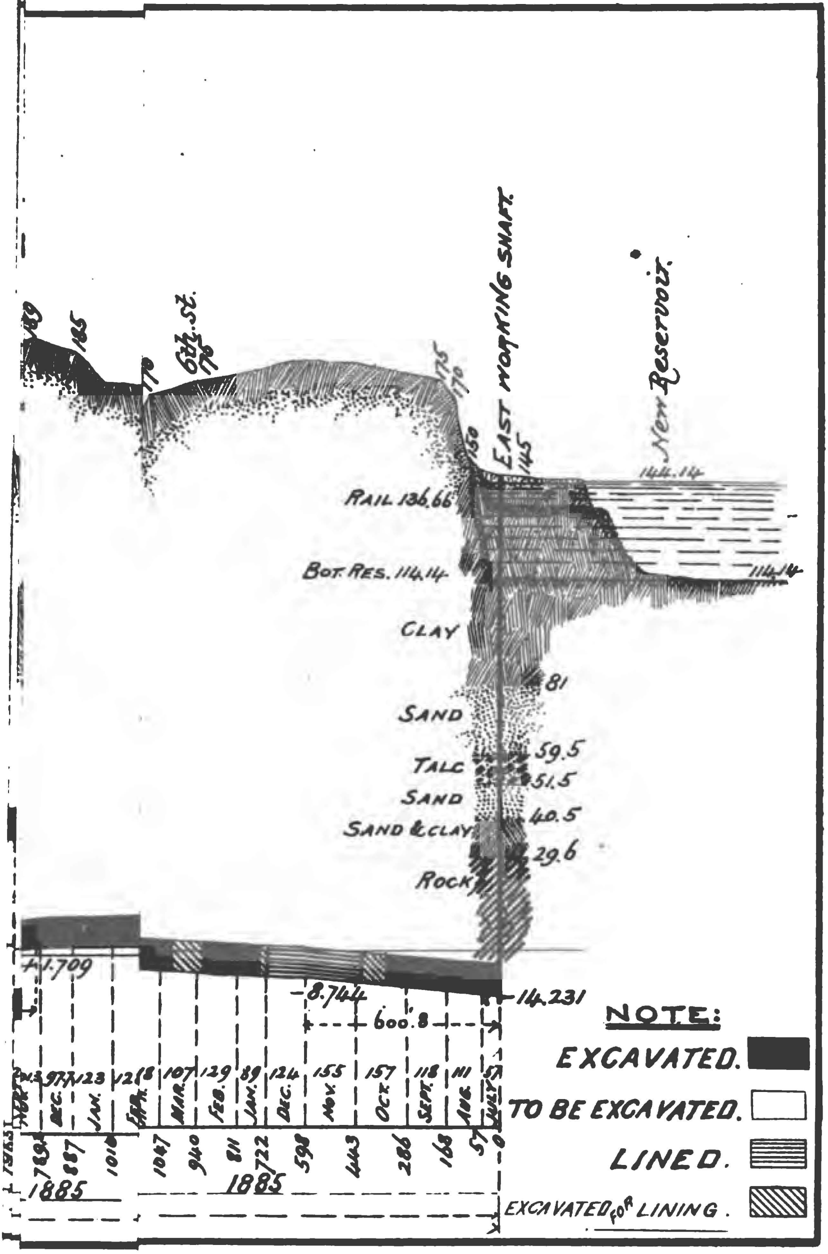
THOMAS W. SYMONS,
Captain of Engineers.

Maj. G. J. LYDECKER,
Corps of Engineers, U. S. A.

MODIFICATION OF PLAN FOR NEW RESERVOIR NEAR HOWARD UNIVERSITY.

OFFICE WASHINGTON AQUEDUCT,
Washington, D. C., June 29, 1885.

GENERAL: The present project for the new reservoir, near Howard University, provides for certain iron pipes to be laid in the bottom of the reservoir, as indicated on the tracing herewith; they were to be thoroughly calked and imbedded in concrete, and were designed to carry off the ordinary flow, sewage, &c., of the small streams entering the site of the reservoir near its northeasterly and northwesterly limits. The *storm*-waters were to be taken off in open channels, except where the depth of excavation required for bringing them to the proper grade necessitated the construction of closed conduits; those flood channels leading around the reservoir unite and discharge below the dam in the stream which now drains the valley in which the reservoir is located.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EAST WORKING SHAFT.
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New Reservoir.
144.14
RAIL 136.66
BOT. RES. 114.14
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SAND
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SAND & CLAY
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ROCK
+1.709
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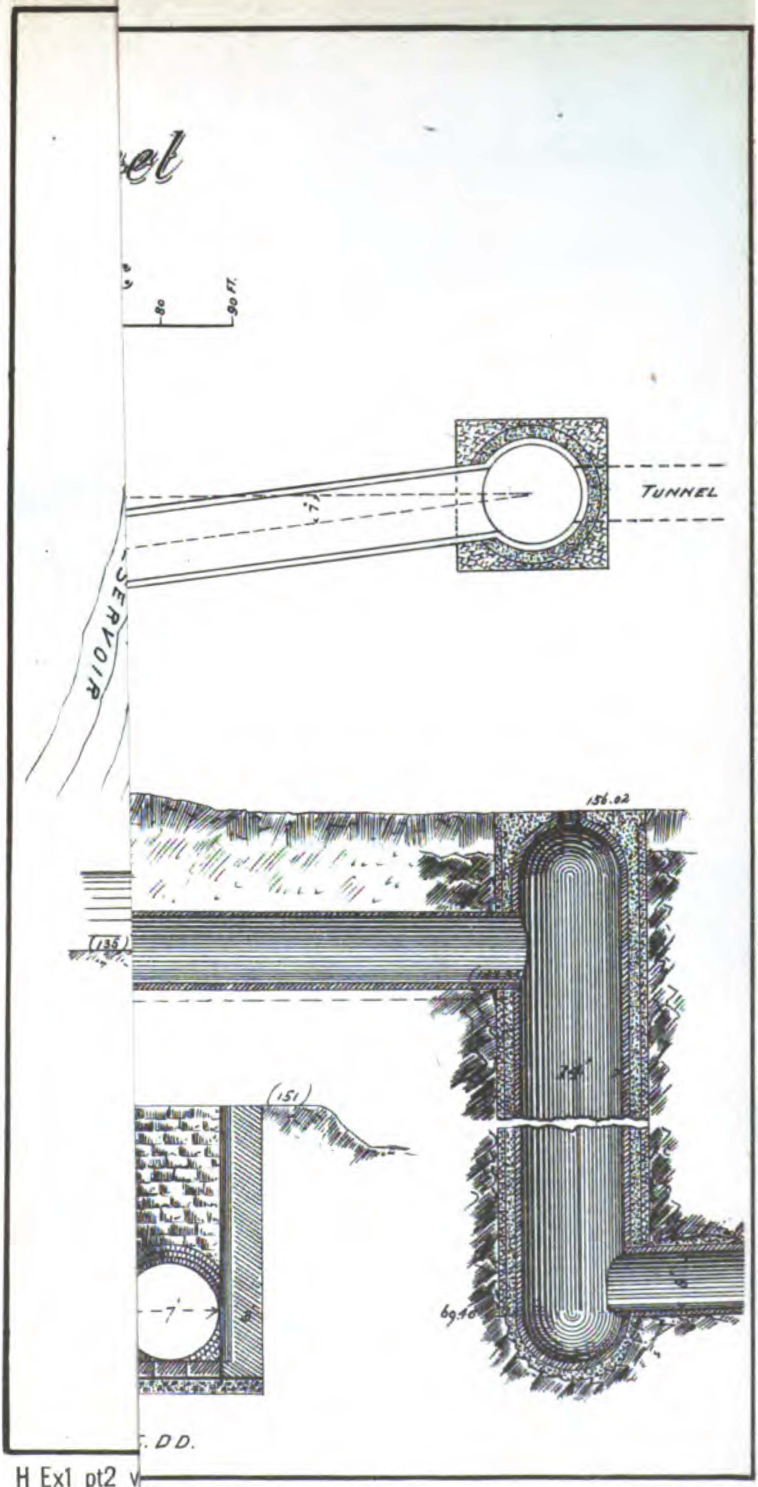

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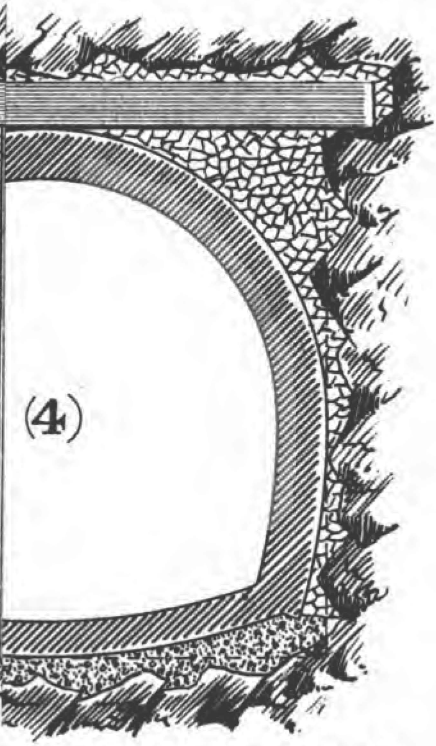

(4)

UNNEL WITH LINING,
TIMBERING.

Thus, on the tracing herewith the iron-pipe drains are indicated by the dotted black lines from the points A, B, and O, passing under the dam to outlet in stream at F; O M L is the east flood channel passing into conduit (L K) and discharging into the stream at F through the open by-wash (K F); A B D is the west flood channel which discharges into the stream at F, through the closed conduit D E F. This is the provision made in the detailed plan of reservoir proposed by Captain Hoxie, and represents the project, as I understand it, on which the appropriation for the work was based, and in the project submitted by me it was my aim to hold to the former unless there appeared strong reasons for changing it. It is my opinion that the particular part of the project now under consideration will accomplish its purpose at the least cost, and that it will properly guard the purity of the water supply. But it has been made quite apparent, recently, that it is necessary not only to so arrange that experts and the more thoughtful among the people shall be perfectly satisfied with the means taken to insure purity of supply, but that these means should, so far as possible, be such as to afford no chance for exciting the alarm or suspicion of any considerable portion of the community.

The arrangements described above do not fill this condition, and for this reason I have now the honor to recommend that the present project be modified, by omitting the iron-pipe drains and substituting closed conduits for the open flood channels; we will then have on the east and south a closed conduit or sewer, extending from P to F, on the line P, O, L, K, F, and on the north, west, and south a like conduit from A to F on the line A, B, D, E, F, the common outlet for both conduits will be through an arched culvert, under Trumbull street, to the stream below. Gutters to intercept the surface flow from the lands surrounding the reservoir will be built where necessary.

Captain Symons's estimate, based on contract prices for like work, shows the increased cost of modifying the plan as herein proposed to be $37,763.81. A copy of his estimate is transmitted herewith. The total amount appropriated for the reservoir, including land damages, is $641,523.75, of which there has been expended to date, including contractors' retained percentages, $441,016.41. An additional appropriation of about $110,000 will be required to complete it according to the existing project, or $150,000 if modified as now recommended.

Very respectfully, your obedient servant,

G. J. LYDECKER,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF THE BOARD OF ENGINEERS CONVENED BY SPECIAL ORDERS NO. 107, HEADQUARTERS CORPS OF ENGINEERS, JULY 15, 1885.

WASHINGTON, D. C., *July* 24, 1885.

The Board having carefully examined into the questions submitted for its consideration, is of opinion that the present project for diverting the flow of the three small streams that pass into and across the site of the reservoir should be modified as recommended by Major Lydecker in his letter to the Chief of Engineers, dated June 29, 1885, viz, by substituting closed culverts or sewers, with connecting gutters above, to intercept all surface-flow, for the iron pipes imbedded in the bottom of the reservoir and for the open flood channels. Sufficient reason for this course is set forth in Major Lydecker's letter, and the Board concurs in the views expressed therein, but in addition to what he states it is to be noted that the iron pipes would be inaccessible at all times when there is water in the reservoir, and could neither be examined nor repaired, in case of accident, until after emptying the reservoir.

The open flood channels, paved with rough blocks of stone, laid dry, would require frequent repairs, and become obstructed by the growth of plants and accumulation of dirt, whereby the free flow of any small volume of water would be checked.

With reference to the probable security of storage and purity of supply in the reservoir, the Board sees no valid reason for mistrust or want of confidence in the plans and methods that are, or are to be, followed by the officer in charge of the work:

First. The streams that now drain the tributary valleys, carrying sewage in their waters to and through the site of the reservoir, will be entirely cut off from entering it.

Second. Such portions of the bottom of the reservoir as have been exposed to the flow of the tributary streams will be excavated and the excavation filled with clay or other suitable material.

Third. A portion of the bottom on the east side, where a bed of carbonized vegetable matter has been uncovered, will also be excavated to a depth of 2 or 3 feet, and the excavation filled with clay thoroughly puddled. And generally this will be done wherever it is necessary.

Fourth. All around the side slopes and underneath the stone revetment will be a lining of puddled clay, wherever necessary, to prevent seepage into or escape of water from the basin.

Fifth. An open paved gutter, over the closed culverts, and surrounding the entire basin, will intercept all surface drainage flowing towards the reservoir.

Sixth. To establish a circulation of water through the reservoir, the supply, as it emerges from the tunnel, will be conveyed through conduits built on the bottom of the reservoir to the three corners most remote from the effluent gate-house; in this way the water will be received at the northwest, northeast, and southeast corners of the reservoir, and have its outflow into the mains at the extreme southwest corner. This constant motion and the disturbance of the water surface by winds will prevent stagnation and serve to keep the water in good condition.

Seventh. The stone riprap on the banks will be carried to a sufficient depth below the water surface to prevent the growth of plants and all wash of the side slopes due to wave action.

It is the opinion of the Board that the modifications herein recommended, and methods of construction outlined as above, all as proposed by the officer in charge of the work, will properly secure the storage and purity of supply in this reservoir.

THOMAS LINCOLN CASEY,
Colonel, Corps of Engineers.
WM. P. CRAIGHILL,
Lieut. Col. of Engineers.
G. J. LYDECKER,
Major of Engineers.

U U 3.

ERECTION OF FISH-WAYS AT GREAT FALLS OF THE POTOMAC.

The act making provision for the erection of these fish-ways required that the plans should be prepared under the direction of the United States Commissioner of Fisheries. They were furnished to this office just before the beginning of the present fiscal year.

It was found, however, that their application involved the use of certain patents, and in fact on the 18th of July, 1884, the secretary of the McDonald Fish-way Company filed a claim for $12,000 royalty, and the matter having been submitted to the Secretary of War, I was instructed to suspend all operations looking to the erection of fish-ways, until this claim was disposed of or until further orders.

Accordingly nothing more was done until the spring of 1885, when on the 18th of March the McDonald Fish-way Company executed a full and free license to the Government to use all its patents in connection with the erection of these fish-ways, and steps were at once taken to place the work under contract. Advertisements for proposals were published April 15, 1885, bids opened May 8, and contract awarded to John E. Lyons at prices which, for the estimated quantities of work shown on the plans as drawn up in the office of the Commissioner of Fisheries, will make the cost of the work $34,160.19.

Work under the contract was begun June 1, 1885, so that up to the close of the fiscal year there had been no substantial progress beyond the preliminary work, such as getting machinery and material on hand, and a small amount of excavation for the foundations.

The total expenditures on account of this work to June 30, 1885, are as follows:

Expenses of surveys	$2,151 08
Paid contractor, estimate for June	978 07
Superintendence, advertising, and job printing	358 80
	3,487 95

Of which amount the sum of $1,336.87 pertains to operations during the past fiscal year.

The amount available for completing the work is $46,403.37, and from present indications it will suffice.

The following is a money statement for the fiscal year ending June 30, 1885:

Amount available July 1, 1884	$47,848 92
Amount expended during the year	208 80
Amount unexpended June 30, 1885	47,640 12
Outstanding liabilities (including retained percentage)	1,236 75
Amount available June 30, 1885	46,403 37

In conclusion I desire to state that Captain Symons's course in all matters relating to the works that have been the subject of this report meets with my warmest approbation, and that I am largely indebted to his professional skill, sound judgment, and close personal application for whatever measure of success I may have attained in the discharge of my duties in connection with these works.

Abstracts of proposals received and opened May 8, 1885, *for the erection of fish-ways at Great Falls.*

No.	Names and residences of bidders.	Stone coping, 90 cubic yards, per cubic yard.	Cut-stone masonry, 202 cubic yards, per cubic yard.	Concrete masonry, 479 cubic yards, per cubic yard.	Riprap backing, 521 cubic yards.	Timber and plank, 93,600 feet, B. M., per M feet, B. M.	Screw-bolts from $2\frac{1}{4}$ to 6 inches, 17,782, each.	Screws from $2\frac{1}{4}$ to 9 inches, 51,664, each.	Wrought iron, 55,320 pounds, per pound.
							Cents.	*Cents.*	*Cents.*
1	John E. Lyons, Baltimore, Md	$28 57	$21 57	$7 70	*$10 15	$63 00	$5\frac{1}{4}$	$5\frac{1}{4}$	$9\frac{8}{10}$
2	Chittenden Brothers, Washington, D. C	45 00	†25 00	8 00	‡1 75	65 00	6	6	10

* Per cord. † Seneca. ‡ Per cubic yard.

No.	Names and residences of bidders.	Earth excavation, 750 cubic yards, per cubic yard.	Rock excavation, 1,655 cubic yards, per cubic yard.	Aggregate cost of items in approximate bill.	If permitted to take and use stone from the Seneca quarry, price as follows:			
					Coping, per cubic yard.	Cut stone, per cubic yard.	Concrete, per cubic yard.	Riprap backing, per cubic yard.
1	John E. Lyons, Baltimore, Md.	$1 40	$2 10	$34,160 19	$27 50	$20 57	$7 20	*$9 65
2	Chittenden Brothers, Washington, D. C	2 00	4 75	41,984 76	35 00	25 00	8 00	†1 75

* Per cord. † Per cubic yard.

Contract awarded to John E. Lyons, dated May 21, 1885.

REPORT OF CAPTAIN THOMAS W. SYMONS, CORPS OF ENGINEERS.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., July 30, 1885.

SIR: I have the honor to submit the following annual report of operations for the fiscal year ending June 30, 1885, * * * of which, by your order, I am superintending engineer.

* * * * * * *

THE GREAT FALLS FISH-WAY.

Just before the close of the fiscal year ending June 30, 1884, the plans, specifications, and detailed drawings of the proposed fish-way at the Great Falls of the Potomac were received at this office.

The original act of Congress for the erection of the fish-ways contained no provision for the purchase or condemnation of land, but a supplementary act, passed during the session of 1883—'84, provided therefor.

On the 18th of July, 1884, the secretary of the McDonald Fish-way Company, wrote a letter demanding a royalty of $12,000 upon the construction of the fish-way according to the plans submitted.

Upon this the whole question was referred by you to the Chief of Engineers and Secretary of War, by letter dated June 29, 1884. Pending decision and final action all work in connection with the fish-ways was suspended, by order of the Secretary of War until further instructions.

On March 18, 1885, the McDonald Fish-way Company executed a full and free license to the Government to use its patented methods, plans, &c., and all papers, plans, &c.,

were returned to this office by the Secretary of War, and Chief of Engineers with instructions to proceed with the work.

Detailed specifications for the construction of the work were then prepared, and on April 16, 1885, advertisements were made for proposals for doing the work.

Bids were opened May 8, and the contract let to Mr. John E. Lyons, of Baltimore, Md. The contract was executed on the 21st day of May, and active operations commenced on the 1st of June.

Mr. R. C. Smead was placed as inspector in charge of the construction of the fish-ways.

During June a temporary dam was built across the Maryland Channel and the overflow channel across Falls Island completed, and the water turned through it.

Work in excavating foundations for the fifth and sixth sections of fish-way were commenced.

The only work accomplished by the contractors during the fiscal year just ended, and for which they are entitled to pay under their contract was the excavation of 517½ cubic yards of rock.

FINANCES OF THE FISH-WAYS.

Appropriation		$50,000 00
Paid and due contractors	$1,086 75	
Surveys and preparation of plans	2,151 08	
Engineering, superintendence, advertising, and printing	358 80	
		3,596 63
Amount available for completing work		46,403 37

It is believed that this will be sufficient.

* * * * * * *

Very respectfully, your obedient servant,

THOMAS W. SYMONS,
Captain of Engineers.

Maj. G. J. LYDECKER,
Corps of Engineers, U. S. A.

APPENDIX V V.

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON.

REPORT OF COLONEL JOHN M. WILSON, UNITED STATES ARMY, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS,
Washington, D. C., July 23, 1885.

GENERAL: I have the honor to submit the following report of operations carried on upon the public buildings and grounds in the District of Columbia, under charge of this office, during the fiscal year ending June 30, 1885.

In compliance with paragraph 6, Special Orders, No. 109, Headquarters of the Army, Adjutant-General's Office, May 13, 1885, I relieved Col. A. F. Rockwell, U. S. Army, of his duties in connection with these works on June 1, 1885.

GROUNDS SOUTH OF THE EXECUTIVE MANSION.

The improved portion of this park received the necessary attention to maintain its beauty; the lawn surfaces were mown, roads raked and rolled, gutters and drains cleaned, trees and shrubs pruned and watered, and a number of park settees placed in position.

During the months of November, 1884, and April, 1885, 1,259 evergreen and deciduous trees and flowering shrubs were planted; during the winter months the entire lawn surfaces were covered with a coating of compost, about 1,900 cubic yards being used for this purpose; for surface grading and planting trees 775 cubic yards of soil was purchased and used; the lower portion of the grounds, bordering on Seventeenth street, was surface-soiled and sown down in grass seed; the worn-down portions of the lawn surfaces, caused by pedestrian travel on the night of March 4, were repaired, top-dressed, and sown with grass seed.

MONUMENT GROUNDS, GREENHOUSES, AND NURSERY.

The Monument Grounds, with the exception of the portion occupied by the Washington Monument and the shops and sheds appertaining thereto, were kept in good order during the year; lawns were mown, roads and walks raked, repaired, and rolled, gutters and drains cleaned and repaired, trees and shrubbery trimmed, and about eight tons of hay secured from these and the Smithsonian Grounds for the maintenance of the public animals belonging to the office.

The Greenhouse buildings were repaired where necessary.

A new plant-house 100 feet by 14 feet was constructed and a wagon-shed put up; a new potting-shed was built connecting two of the green-houses; a new conical boiler was put in position to replace one that was unserviceable.

About 200,000 ornamental foliage and flowering plants were propagated in the greenhouses during the fall, winter, and spring, and were planted in the parks during the months of May and June; the crotons, palms, and sub-tropical plants were removed from the greenhouses and used in beds and vases for the summer decoration of the reservations.

In the Nursery Grounds the young growing stock was well cared for, having been pruned, mulched, and transplanted when necessary; in October, 1884, 3,000 young trees and shrubs were transplanted; in April 2,500 cuttings of hardy flowering shrubs were planted in the propagating beds, and in May 2,000 seeding trees were removed from boxes and placed in nursery rows.

The stock was increased by the purchase of 75 trees and 1,000 shrubs, which were set out in the Nursery Grounds for acclimation before final planting.

About 3,300 trees and shrubs were removed from the Nursery and set out in the public parks during the year.

About 17,000 spring flowering bulbs were purchased and used for early spring decoration of the larger improved parks.

SMITHSONIAN GROUNDS.

These grounds received all necessary care and attention; the lawns were regularly mown and raked, gutters and drains cleaned and repaired, trees and shrubs pruned, and some decayed and unsightly trees removed.

Eight hundred and fifty cubic yards of gravel were used in repairing and resurfacing roads; 3,700 linear feet of new brick gutters were built and 400 linear feet of old gutters relaid; thirteen drain traps were constructed and connected with sewers by 500 feet of 6-inch and 323 feet of 8-inch terra-cotta pipe.

Temporary wooden walks were put down in the autumn for the convenience of pedestrians, and taken up in April and stored at the nurseries.

ARMORY SQUARE AND RESERVATIONS EAST TO BOTANICAL GARDENS.

The small amount of funds available for this park rendered it impossible to pay as much attention to it as it deserves.

The roadways and walks were repaired and rolled; lawns mown, raked, and rolled; sod margins edged, trees and shrubs pruned, and a number of park settees placed in position.

The park is visited by many citizens, and, from its situation between the Smithsonian Grounds and Botanical Gardens, can be made very beautiful. The portion east of the Baltimore and Potomac Railroad has never been named, and I respectfully recommend that hereafter it be designated as Seaton Park, in honor of that distinguished citizen, the late W. W. Seaton, who was so greatly interested in the welfare and prosperity of this city, and who for many years, as the editor of the National Intelligencer, was a representative man of the press in this section of the country.

RESERVATIONS NORTH OF PENNSYLVANIA AVENUE AND WEST OF THE CAPITOL.

At Lafayette Square the lawns were coated with 270 loads of manure during the winter; new slate floors and wainscoting were placed in position, and other repairs made in the closets. In November 3,434 flowering bulbs were planted; during the season the lawns were mown, raked, and rolled; trees and shrubs pruned and watered, and beds of ornamental foliage and flowering and tropical plants set out; vases were filled with tropical and other plants; the gravel walks were repaired and rolled, and the gutters and drains cleaned and repaired where necessary. It is proposed hereafter to keep this park, which has heretofore been closed at 11 p. m., open all night.

At Franklin Square the usual care and attention have been extended to the beautiful grounds. The gravel walks have been repaired, raked, and rolled, and during the winter a temporary wooden walk was laid from I to K streets for the benefit of pedestrians; new slate floors and wainscoting were placed in position, and other repairs made to the closets; 900 linear feet of brick gutters were laid, a new sewer-trap constructed and connected, and three drain traps reconnected with terra-cotta pipe; 4,392 flowering bulbs were planted during the year; lawns were mown, gutters and drains cleaned and repaired, and many exquisite beds of ornamental foliage, flowering, and tropical plants set out. All trees and shrubs were pruned where necessary.

Franklin is one of the most ornamental parks in the city, and I have been urged by residents in the vicinity to open for the public use the fine spring which in years past was frequented by the people. I earnestly recommend an appropriation for this purpose. It is proposed to construct a grotto which will be an ornament to the park and will be useful to the people.

At Mount Vernon Square the lawns were mown and rolled; gravel paths repaired, raked, and rolled; gutters and drains cleaned and repaired; trees and shrubs pruned, and beds of ornamental foliage and flowering plants set out. A plank walk was placed on the line of Eighth street during the winter, for the benefit of pedestrians, and removed in April.

At Judiciary Park, 2,100 linear feet of brick gutters and six drain lodges were constructed; new terra-cotta pipe connections were made with drain lodges that had become choked; temporary plank walks for pedestrians were laid during the winter; the floors of the closets were repaired, and a new granolithic pavement laid.

The portion of the grounds not occupied by the new Pension building received the usual care and attention; gravel paths and roads were raked, repaired, and rolled; lawns mown and raked; trees and shrubs pruned; gutters and drains cleaned and repaired; beds of ornamental foliage and flowering plants set out, and 2,005 flowering bulbs planted. In anticipation of the early completion of the Pension building, a special appropriation is asked for the coming year with which to put this central park in complete order and beautify it, as its location deserves.

All the smaller improved reservations throughout the city received the usual attention necessary to keep them in good condition; lawns were mown, gravel paths repaired, flower beds planted, and trees and shrubs pruned and mulched as required.

The iron railing at the reservation bounded by Third and M streets, New York and New Jersey avenues, was removed out to the paving line, and the space gained graded and soiled; the fountain here was taken down, the iron basin removed, a new concrete basin made, and the granite coping reset; 1,406 flowering bulbs were planted in Farragut Square, and 1,035 in Thomas Circle. The gravel walks in the triangles on Pennsylvania avenue between Eighteenth and Twenty-first streets were recoated with fine gravel and rolled, and worn-down places in the lawns resodded; the post-and-chain fence at Eighteenth street was extended to the brick pavement line, a flower bed 20 feet in diameter laid out, and additional trees and shrubs planted.

The unimproved triangle at New Jersey avenue, Third and N streets northwest, formerly 6 feet above grade, was reduced to correspond with street grades. The pavement and curbing around Thomas Circle were reset, and a suitable inscription was cut upon the pedestal of the statue.

DU PONT CIRCLE AND STATUE.

On November 24, 1884, the bronze statue of Rear-Admiral Du Pont was placed in position on its pedestal by the contractor, and was formally accepted by the Secretary of War on December 3; the statue was unveiled under the auspices of the Navy Department on December 20, 1884.

Du Pont Circle was well cared for during the year, and is rapidly becoming an ornament to the northwest section of the city; the lawns have been mown, trees and shrubs planted and pruned, and many beds of ornamental and flowering plants set out; new benches have been placed in position, and the park is now much frequented by residents in the vicinity.

WASHINGTON CIRCLE.

This circle has been greatly improved during the year; the iron fence has been removed, the granite boundary coping stones dressed and reset; grounds brought to proper grade and surface soiled; new paths laid out, coated with screened gravel, and rolled; lawn surfaces sown down in grass seed and winter rye; water pipes extended and two drinking fountains with large ornamental gas lamps erected; ten lamp-posts were placed in position on the margin of walks.

Seven hundred cubic yards of soil were purchased and used for top-grading purposes, and 200 cubic yards of gravel for walks. Old and decayed trees were removed and the park greatly improved in appearance; settees were placed in position, and the circle is now becoming a place of resort for the residents in the vicinity.

RESERVATIONS EAST OF THE CAPITOL.

The usual care and attention were given to the various reservations in this section of the city; lawns were mown and raked, gravel paths repaired, gutters and drain-lodges cleaned, trees and shrubs pruned, and beds of ornamental foliage and flowering plants set out.

At Lincoln Park a new slate floor, new wainscoting, &c., were placed in the watchman's lodge.

In reservation at the corner of Delaware avenue and First street the post-and-chain fence was removed and reset, and forty-one sycamore trees planted in this and adjacent triangles.

Sixty feet of 2-inch water pipe was laid in the triangle at the intersection of Massachusetts avenue, Seventh and B streets northeast, and an outlet provided for one hose-valve.

RESERVATION ON SOUTH CAROLINA AVENUE, BETWEEN FOURTH AND SIXTH STREETS.

The surface grading of this reservation was completed, about 1,200 cubic yards of soil having been used for this purpose; lawn surfaces were sown down in grass seed; gravel roads laid out with 200 cubic yards of gravel; 480 linear feet of 3-inch and 82 feet of 2-inch water-pipe laid, and outlets provided for three hose-valves.

About 1,800 linear feet of straight and circular curbstone was hauled from the Nursery Grounds and laid on the north and south sides of the reservation and along the roadway around the circle.

RESERVATION ON NORTH CAROLINA AVENUE, BETWEEN SECOND AND THIRD STREETS, EAST—FOLGER PARK.

Extensive improvements were made at this park during the year; the granite fountain coping, formerly in Armory Square, was re-erected here, a new basin constructed, and drain-pipe laid; 300 feet of 3-inch and 250 feet of 2-inch iron water-pipes were laid and outlets prepared for four 1¼-inch hose-valves; the gravel paths were repaired and rolled, and their margins resodded where worn down; the lawns were top-dressed with compost, resown with grass seed and winter rye, raked and rolled; about 1,000 ornamental evergreen and deciduous trees and shrubs were planted, staked, and wired; a number of park settees were placed in position.

This park has been greatly improved, and adds much to the beauty of the locality. The reservation is immediately in front of Providence Hospital.

RESERVATION NO. 17—GARFIELD PARK.

Operations were continued during the year—grading, setting curb, laying out walks and roads, placing water-pipes in position, &c.; 5,500 cubic yards of soil, 1,200 cubic yards of gravel, and 400 cubic yards of earth were purchased and used in this park during the year; 4,818 linear feet feet of iron water pipe, from 1 to 4 inches in diameter, was placed in position and outlets introduced for twenty-three 1¼ inch hose-valves; 1,351 deciduous trees were removed from the Monument Nursery and planted in a temporary nursery at the reservation; they will be set out in the fall of 1885; about 1,000 feet of granite curbing was set on the boundaries of the reservation bordering E street, and 1,000 feet rejointed and prepared for setting on the northwestern boundary lines of the park.

During the present season operations will be continued; setting curb, laying brick sidewalks, laying out roads and paths, planting trees, &c.; about 3,000 yards of soil, 2,000 yards of gravel, and 50,000 brick will be purchased for these purposes.

SETTEES, IRON FENCES, TOOLS, MANURE, ETC.

Fifty new park settees were purchased during the year and placed in position in the grounds of the Executive Mansion, at Washington and Du Pont circles; several hundred old settees were repaired, painted, and refastened throughout the various reservations, particularly in the Smithsonian Grounds, Lafayette, Franklin, Judiciary, Farragut, McPherson, and Lincoln squares.

Minor repairs were made to the iron fences at many of the reservations, and the fences painted at Lincoln, Stanton, Folger, Franklin, McPherson, Farragut, Lafayette, Rawlins, Mount Vernon, Iowa, and Judiciary squares, at forty-three smaller reservations, and at a portion of the Smithsonian Grounds; thirty-nine lamps and posts were painted about the Executive Mansion, ten plant-tubs in Lafayette Square, and twenty-three vases in various parks; the iron vases in McPherson Square were bronzed. A blacksmith and helper were employed during the working season repairing and sharpening tools in daily use in the public grounds, and new tools were purchased from time to time to replace those worn and unserviceable.

Additional signs, warning trespassers, were prepared and placed in position.

About 1,350 cubic yards of manure and 800 cubic yards of rich soil were purchased and thoroughly incorporated, making about 3,000 cart-loads of rich compost which was spread upon the park lawns. A large temporary force was employed during the months of December, January, and February promptly removing snow and ice from the walks and pavements.

FOUNTAINS.

The fountains and basins were repaired and repainted on Pennsylvania avenue between Eighteenth and Twenty-first streets, and that at the junction of M and Twenty-seventh streets repaired, painted, and a new drain laid to the sewer. A portion of the terra-cotta drain of the drinking-fountain in McPherson Square was taken up, cleaned out and relaid, a fountain was erected in Folger Park, and new jets were placed on those at corner of Twentieth and P streets, Massachusetts and New York avenues, and Third and M streets; the iron work of the various fountains in the public grounds was painted. In the late autumn the basins of the stone and cement fountains were filled with leaves and their copings covered with evergreen brush to protect them from the action of frost; this covering was removed in the spring and the water turned on.

WATER-PIPES AND FIRE-PLUGS.

The necessary care was bestowed upon the water-pipes and fire-plugs during the year; in the autumn the water was shut off from the public grounds, the hose-valves removed from the pipes and stored for the winter. The latter were replaced in the spring and the water turned on; 6,061 linear feet of iron water-pipe from 1 to 4 inches in diameter was laid during the year, mostly in Reservation No. 17, reservation on North Carolina avenue, between Second and Third streets, and that on South Carolina avenue, between Fourth and Sixth streets. The Capitol Spring pipe at North Capitol and O streets was cut and extended over the sewer built by the District Commissioners, and the 4-inch valve at North Capitol and Boundary streets was taken out, cleaned, repaired, and replaced; 1,200 feet of $\frac{3}{4}$-inch and 1,000 feet of $1\frac{1}{4}$-inch rubber hose were purchased during the year.

PARK LAMPS AND LIGHTING.

The usual attention was paid to the lamps during the year; the lamp-posts were repainted and the lanterns reglazed and cleaned when necessary; the average number of lamps lighted nightly was 337, each lamp burning about 2,600 hours and consuming about 15,600 cubic feet of gas.

BRIDGES.

The bridges were maintained in good condition.

The causeway leading to Benning's Bridge was regraveled and 6,048 feet, board measure, of Georgia pine plank laid down on the roadway, the worn-out plank being removed and hauled to the nursery for use as temporary foot-walks; minor repairs were made from time to time to the Anacostia Bridge; extensive repairs were made to the Chain Bridge, decayed stringers and plank being removed and replaced by new ones; in this work 12,960 feet, board measure, of Georgia pine stringers and 16,293 feet, board measure, of Georgia pine plank were used.

At the close of the year these bridges were in tolerable repair, but the roadways of all three will require entire renewal at an early day.

EXECUTIVE MANSION.

The following work was done in the Executive Mansion during the year:

Carpets were removed, shaken, and relaid; curtains taken down, repaired, cleaned, and put up; a new automatic filter and a new large refrigerator were placed in the basement; new matting and eight pairs of lace curtains were purchased and placed in the east room; additional costly articles of furniture, such as cabinets, vases, also carpets and matting were placed in the parlors, and extensive repairs made to furniture already there; the fireplaces in two rooms were enlarged, cased with fire-brick and furnished with portable nickel-plated grates.

New gas fixtures were placed in the basement corridor, new crystals furnished for east room and state dining-room chandeliers, the crystals and glass of all chandeliers cleaned, and four gilt chandeliers and one side bracket replated; the stoves, ranges, fireplaces, furnaces, and chimneys were cleaned and repaired where necessary; a new waste-pipe valve was put in the house supply tank; new down-spouts put up to east portico; the brick pavement on the east front was relaid; the basement and outside areas were whitewashed and the stone floors repaired; the roof of the east portico, the lamps and fences in front of the north portico, the bases of the portico columns and the pillars of the north park gates were repainted; nine lamps around the mansion were repainted and regilded; the wood work of the small reception room off of the main vestibule, the wood work and walls of the public hall and of five of the upper rooms were repainted and one room repapered. The ceiling of the state dining-room, where discolored and injured, was refrescoed; two new chandeliers were hung in one of the executive office rooms; the copper roof was repaired and minor carpentry and plumbing work done from time to time.

The usual care was bestowed upon the greenhouses; all broken glass was replaced and wooden staging repaired; a new drain was laid in the rose-house; the boilers were cleaned and repaired when necessary, and the brick floors in the furnace-room coated with artificial-stone pavement; a new water-tank and two new slate benches were built in the camelia house and one slate bench in the propagating house. A large number of decorative and flowering plants were raised for bedding purposes during the year.

The large conservatory needs extensive repairs, and for the safety of the building should have a new concrete floor at once.

Minor repairs were made to the stables, including pointing walls, kalsomining, painting, &c.; the interior of the stables needs extensive repairs, which will be made at once.

In the grounds of the Executive Mansion the lawns were mown and raked, walks repaired, raked and rolled; trees and shrubbery pruned, basin of large fountain repaired and eight brick pockets built in it, in which to plant water lilies. A temporary plank walk was laid through the grounds in January and removed in April. A large number of ornamental foliage, flowering, and tropical plants were removed from the greenhouses in the spring and set out in the grounds; several evergreen trees were transplanted and some new ones set out; the urns and vases were repainted and filled with plants.

TELEGRAPH TO CONNECT CAPITOL WITH DEPARTMENTS, ETC.

The main and local batteries in this office and in the different executive buildings received careful attention during the year, and were maintained in good working order; the wires from the Treasury Department to the Quartermaster-General's Office and the Bureau of Statistics were taken down and re-run; 225 feet of six-conductor underground cable were run into the basement of the United States Senate to complete the connection; the old wires entering the Government Printing Office were removed and replaced with new ones; the old two-wire cable was removed from the roof of the Post-Office Department and replaced by new wires; at the request of Professor Baird the National Museum was connected with the line, the necessary wire run, and a set of instruments put in the office; all slack was cut from the wires and all useless fixtures removed from buildings and replaced by new ones; two old poles were replaced with new ones and four poles re-set; fifty-four poles have been painted; all instruments and switch-boards in use were kept in good order.

The underground cable which was torn up and broken in June by the carelessness of men engaged in street improvements was promptly repaired.

Mr. A. J. Kennedy, the electrician connected with this office, has been earnest, active and vigilant in the discharge of his duties.

SURVEYING AND DRAUGHTING.

The duties of the draughtsman required his personal attention at all times; when required, to exhibit to those interested the public records of Washington City, in the Office of Public Buildings and Grounds; he is also frequently summoned to produce these records in the courts.

During the year, in addition to these duties, he has made surveys and prepared plans of Farragut, McPherson, Du Pont, Folger, and Iowa Parks and adjacent triangles, and also of improvements in progress in the grounds south of the Executive Mansion, in Washington Circle, Garfield Park, and Reservation No. 18.

Attention is invited to the fact that the original map of the city of Washington on file in this office, which was approved by President Washington on March 2, 1797, has become so dilapidated by constant handling in court and elsewhere that it will soon be totally useless. This map was prepared by Mr. James R. Dermot, the city surveyor, in 1796.

It is recommended that an appropriation of $500 be made for preparing a correct copy of this original map, and that after its approval by the Secretary of War it be considered as available for use in courts of law, and the old one be filed away as a relic of the past.

NUMBER AND AREA OF RESERVATIONS.

The number and area of public reservations, &c., under charge of this office, are as follows:

Description.	Number.	Area.	
		Acres.	*Sq. ft.*
Total number of reservations	246	408	20,083
Reservations highly improved	38	236	14,052
Reservations partially improved	47	112	30,679
Reservations unimproved	161	59	19,812
Reservations inclosed	76		

Statues, 10; fountains, 22; drinking fountains, 23; gas-lamps, 414.

ESTIMATES FOR THE FISCAL YEAR ENDING JUNE 30, 1887.

Salaries of employés of Public Buildings and Grounds, &c.:		
For one clerk	$1,600	
For one messenger	840	
For one public gardener	1,800	
For overseers, foremen, draughtsman, mechanics, laborers, &c.	30,000	
One day-watchman, Franklin Square	660	
One night-watchman, Franklin Square	660	
One day-watchman, Lafayette Square	660	
One night-watchman, Lafayette Square	660	
Two day-watchmen in Smithsonian Grounds, at $660 each	1,320	
Two night-watchmen in Smithsonian Grounds, at $720 each	1,440	
One watchman, Judiciary Square	660	
One watchman, Lincoln Square and adjacent reservations	660	
One watchman for Iowa Circle	660	
One watchman for Thomas Circle and neighboring reservations.	660	
One watchman for Rawlins Square and Washington Circle	660	
One watchman for Du Pont Circle and neighboring reservations.	660	
One watchman for McPherson and Farragut Squares	660	
One watchman for Stanton Place and neighboring reservations.	660	
Two day-watchmen for Armory Square and reservations east to Botanical Gardens (Seaton Park)	1,320	
One night-watchman for Armory Square and reservations east to Botanical Gardens (Seaton Park)	720	
One watchman for Mount Vernon Square and adjacent reservations	660	
One watchman for greenhouses at the Nursery	660	
One watchman for grounds south of Executive Mansion	660	
		$48,940
For contingent and incidental expenses, office Public Buildings and Grounds		500
For rent of office, Public Buildings and Grounds		900
Improvement and care of public grounds:		
For improvement of grounds north of the Executive Mansion	$20,000	
For improvement and maintenance of grounds south of the Executive Mansion	10,000	
For ordinary care of greenhouses and Nursery	2,000	
For ordinary care, Lafayette Square	1,000	
For ordinary care, Franklin Square	1,000	
For care and improvement of Reservation No. 3, Monument Grounds	4,000	
For continuing improvement of Reservation No. 17 and site of old canal northwest of same	10,000	
For construction, removal, and repair of iron fences	1,500	
For manure and hauling same	5,000	
For painting iron fences, vases, lamps and lamp-posts	2,000	
For purchase and repair of seats	1,000	
For purchase and repair of tools	2,000	
For trees, tree stakes, lime, whitewashing, and stock for Nursery	3,000	

Improvement and care of public grounds—Continued.		
For removing ice and snow	$1,200	
For flower pots, twine, baskets, and lycopodium	1,000	
For care, construction, and repair of fountains in the public grounds	1,500	
For abating nuisances	500	
For improvment, care, and maintenance of various reservations.	20,000	
For improvement, care, and maintenance of Smithsonian Grounds	15,000	
For improvement and care of Armory Square and reservations east to Botanical Gardens (Seaton Park)	5,000	
For improving grounds around the Pension building, Judiciary Square	8,000	
For an ornamental open structure of masonry and iron over the spring in Franklin Square	2,000	
		$116,700
Care of and repairs, fuel, &c., Executive Mansion:		
For care, repair, and refurnishing the Executive Mansion	16,000	
For fuel for the Executive Mansion and its greenhouses	3,000	
For care and necessary repairs of greenhouses	5,000	
For repair of conservatory of Executive Mansion	6,000	
		30,000
Care and repair of bridges:		
For two draw-keepers at the Navy-Yard and Upper Bridges (Anacostia and Benning's) at $720 each	1,440	
For one bridge-keeper at Chain Bridge	660	
For ordinary care of Anacostia, Benning's and Chain bridges, including fuel, oil, lamps, matches, &c	2,000	
For replanking and painting Anacostia Bridge	5,500	
For raising causeway and approaches to Benning's Bridge, construction of retaining walls and guard railing where road crosses marsh	10,000	
		19,600
Lighting the Executive Mansion and public grounds:		
For gas, pay of lamp-lighters, gas-fitters, and plumbers; for gas-fitting and plumbing; purchase and erection of lamps and lamp-posts; purchase of matches and repairs of all kinds; fuel and lights for office and stable, for watchmen's lodges, and for the greenhouses at the Nursery		15,000
Repairs to water-pipes and fire plugs:		
For repairing andextending water-pipes, purchase of apparatus to clean them, and for cleaning the springs and repairing and renewing pipes of the same that supply the Capitol, the Executive Manison, and the building for the State, War, and Navy Departments		2,500
Telegraph to connect the Capitol with the Departments and Government Printing-Office:		
For replacing the entire overhead system of wires with duplicate six-conductor underground cable, being a total distance of about 11,000 linear feet	$10,500	
For care and repair of existing lines	1,500	
		12,000
For copying the original map of Washington City		500
Total		246,640

In submitting these estimates, some of which are for larger amounts than heretofore appropriated and some for entirely new work, the following explanation is presented:

First. For overseers, foremen, draftsmen, mechanics, laborers, &c., $30,000.

The amount appropriated for the fiscal year ending June 30, 1886, is $26,000; an increase of $4,000 is requested.

The parks and reserved public spaces in charge of this office comprise an aggregate area of about 408 acres. They are widely distributed, and were evidently intended to be highly improved and to receive such permanent care as would render them ornaments to the nation's capital. The greater portion of the largest of these parks are generally located in the vicinity of the principal thoroughfares and have been highly improved. They are at present popular places of resort. A number of the small reservations in prominent sections of the city have also been highly improved and form attractive spots of verdure amid their brick and stone surroundings. This year four more of these will be improved. The beauty of these parks depends, in a great measure, upon the neatness and order in which they are kept. Their lawn surfaces require frequent mowing, and should be freely watered during the summer months, while their walks, ornamental evergreen and deciduous trees and shrubs, their flower-beds, &c., require unremitting attention to preserve them in best condition.

The present regular working force of gardeners and laborers employed, provided mainly from this appropriation, is not sufficient to fully perform the duties required. The most necessary work in many of the parks can only be performed, and minor but important duties are neglected, to the detriment of the ornamental character of the grounds. The area of improved parks is annually increasing by the completion of work for which special appropriations have been provided, and a corresponding increase in the working force must be made to maintain them in their improved condition.

Second. Night-watchmen, at a cost of $660 each per annum, are requested for Franklin and Lafayette squares.

These parks are prominent resorts for recreation and pleasure of citizens in the section of Washington in which they are situated. They are generally more frequented in the evening after the hours of labor of the day-watchmen are over, and for the protection of the citizens and of the property of the United States and the preservation of the trees, shrubs, and plants, that add so much to the beauty of the parks, night-watchmen are necessary.

Third. A park watchman is recommended for the grounds south of the Executive Mansion.

This recently improved park is much frequented by pedestrians, and the roadways form one of the most popular carriage drives in the city. The protection of the park improvements and the maintenance of regulations for the comfort of visitors render the appointment of a watchman imperatively necessary.

Fourth. For the improvement of the grounds north of the Executive Mansion, $20,000.

With this appropriation it is proposed to remove the old worn and broken flag pavement and the boundary wall on the Pennsylvania avenue front of the Executive Mansion Grounds, which are not in keeping with the surrounding improvements, to lay down a substantial dressed North River bluestone flag pavement of large size, similar to the adjoining pavement of the State, War, and Navy Departments building, and to construct a suitable ornamental granite boundary wall with piers and coping stone and a low iron railing; also to resurface with Portland cement pavement the interior walks of these grounds.

Fifth. For improvement, care, and maintenance of grounds south of the Executive Mansion, $10,000.

It is proposed to expend this sum as follows:

For purchase of gravel and for labor required for resurfacing the roads and paths and for construction of additional walks, $3,000.

For purchase of soil, grass seed, and fertilizers, and for maintaining the lawns in good condition, $800.

For ornamental trees and shrubs, and labor of planting and caring for them, $1,000.

For purchasing and erecting four drinking fountains and making the necessary water and sewer connections, $800.

For constructing 400 linear feet of ornamental stone wall, with piers and coping stone, required for the northeastern boundary of the park, $3,200.

For constructing a park lodge provided with conveniences for public comfort, $1,200.

Sixth. For care and continued improvement of Reservation No. 3, Washington Monument Grounds, $4,000.

It is proposed to maintain in good condition the roads, walks, and lawn surfaces, and to construct additional walks for the convenience of travel through these grounds in portions which would not be liable to change by the construction of terrace slopes or other improvements which may be adopted in completing the work around the base of the monument.

Seventh. For continuing improvement of Reservation No. 17 (Garfield Park), $10,000.

It is proposed to continue the work in progress for the improvement of this park, to lay out roads and paths, construct gutters, drains, sewer-lodges, and to plant trees and shrubs; of the amount estimated, $4,000 will be applied to the purchase of gravel, soil, cobble-stone, drain-pipe, brick, &c., and $6,000 to the labor of construction.

Eighth. For removing snow and ice, $1,200.

The amount appropriated for this fiscal year is $1,000; for the year ending June 30, 1884, this amount was not sufficient. I have asked for $200 more to provide for contingencies; if the winter is mild it will not all be used.

Ninth. For improvement, care, and maintenance of various reservations, $20,000.

It is proposed to provide materials and labor for maintaining in good condition the partly improved parks and to continue their improvement; to furnish materials required for the maintenance of the highly improved parks for which no special appropriation is provided, and to continue the improvement of totally unimproved public spaces in various sections of the city, the surroundings of which have been highly improved by the citizens.

The amount of increase over the appropriation for the present year is imperatively needed for the prosecution of the following work, which should be done during the next fiscal year:

The reconstruction of the concrete walks in Iowa Circle; repairing and resurfacing, in part, the asphaltum walks in Rawlins, McPherson, and Farragut parks; construction of asphaltum walks on principal lines of travel in Washington Circle, Stanton, Folger, Judiciary, Mount Vernon, and other parks, the foot-walks of which have become public thoroughfares; it is also proposed to construct suitable small, ornamental lodges for watchmen in Du Pont, Iowa, Mount Vernon, and other parks.

Tenth. For improvement, care, and maintenance of the Smithsonian Grounds, $15,000.

This park contains the Smithsonian Institute, the National Museum, and the site for the Medical Museum, which will be commenced this year.

It is proposed to provide materials and labor to maintain the park in good condition, and to coat with concrete material, similar to that in use by the District government for street surfaces, the principal roadway approaches to the Smithsonian Institute and the National Museum; owing to the increased travel of vehicles over these roads it has been found impracticable to maintain them, with their present gravel surfaces, in good condition during the winter months.

It is also proposed to construct a suitable park lodge with the necessary conveniences for public comfort.

Eleventh. For improvement of Armory Square and reservations east to Botanical Gardens, the reservations to be hereafter known as *Seaton Park*, $5,000.

These parks comprise an area of about 30 acres, with road and walk surfaces of over 10,000 square yards; the approaches to the Armory building, now used by the Fish Commission, are in bad condition, and need extensive repairs; it is proposed to put the roadways and walks in complete order, to construct gutters, drain-lodges, &c.; to improve the lawns and to plant additional trees and shrubs.

Twelfth. Improving grounds around Pension building, Judiciary Square, $8,000.

This building, now nearly completed, is already occupied; suitable approaches to it, through the park, have not been provided, and the grounds around it are blocked with piles of earth and clay removed from the foundation. It is proposed to grade and plant these grounds, about four acres, with ornamental trees and flowering shrubbery, to form lawns and flower beds where practicable, and to construct concrete walks in the direct lines of travel from the surrounding streets.

Thirteenth. For constructing an ornamental structure of masonry and iron over the springs in Franklin Square, $2,000

The springs in this park are deemed especially valuable by the residents in the vicinity and are not now available. I have been urged to open them for the benefit of the public; it is proposed to make the necessary excavation, to inclose the springs with masonry, to construct granite steps descending to them, to surmount them with an ornamental structure which will be an attractive feature of the park, and to make approaches to it from the park walks.

Fourteenth. For raising the causeway approaches to Benning's Bridge, constructing retaining walls and placing guard railings where the roadway crosses the marsh, $10,000.

This roadway is now periodically overflowed by the high spring freshets, subjecting the residents of a large section of the adjacent country to personal inconvenience and loss by closing this important avenue to the city of Washington; it is proposed to raise the low portions of the roadway about 3 feet, to construct retaining walls to prevent spreading into the adjacent marsh, and to put up guard railings.

Fifteenth. For constructing, removing, and repairing iron fences, $1,500.

This appropriation has heretofore been $500, and has been devoted to construction and repair; $1,000 is added to it, and is submitted without recommendation The question of removing the tall iron fences from around the parks has been widely discussed and opposite views expressed by distinguished citizens. I have been strongly urged to take action and remove them at once, the reasons given being that the driving of cattle through the streets and the roaming at large of animals is no longer permitted; moreover, it is said that, by confining outlets to certain localities, the police find it difficult to reach persons requiring their assistance. In view of the decided opinion of Congress, as indicated in the act of March 3, 1877, which specially prohibits the removal of iron fences, I have declined taking other action than to respectfully submit this estimate without recommendation, understanding that if the appropriation is made it will be the wish of Congress that the fences shall be removed.

Sixteenth. For care and repair of and refurnishing the Executive Mansion, $16,000.

It was found that by repairing and patching the roof of the Mansion at a small cost a new roof would probably be unnecessary during this fiscal year, so that the $4,000 appropriated for that purpose will probably not be used. It is respectfully urged that the entire sum estimated may be appropriated for the coming fiscal year, so that if absolutely necessary a new roof may be constructed, and if not, the funds may be applied to refurnishing some of the bedrooms where the furniture is shabby.

Seventeenth. For care and necessary repairs of the Executive Mansion greenhouses, $5,000.

The sum appropriated for the past two years has been only $4,000, while previous to that for several years it was $5,500. While I will be able to make absolutely necessary repairs now required, the available funds will not admit of much needed painting, and it is recommended that for the next fiscal year the sum of $5,000 be appropriated.

Eighteenth. For repairs to conservatory, Executive Mansion, $6,000.

The floor of this building is in such bad condition that in wetting down the plants the waste water percolates through the brick arches and endangers the safety of the structure. It should at once be replaced with a new covering of asphaltum; the old wooden benches should be replaced with slate slabs on iron frames, and new heating pipes should replace the old ones, which are in bad condition and of insufficient capacity.

The necessity for this work cannot be overestimated, and it is hoped that this appropriation will be made.

Nineteenth. Care and repair of bridges.

For two draw-keepers at Navy-Yard (Anacostia) and Benning's Bridges, $1,440.

It is respectfully recommended that provision be made for two bridge-keepers for this service, as in former years.

The draw of the Anacostia Bridge is required to be opened for small vessels running to the almshouse and jail and to the upper waters of the Eastern Branch. The services of two men are required to open this draw, and in addition to this service they have been employed in making minor repairs to this and to Bennng's Bridge, the latter about 2 miles above.

Twentieth. For replanking the roadway and foot-walks and repainting iron-work of Anacostia Bridge, $5,500.

This bridge is probably subjected to more travel than any other in the District of Columbia, being the direct approach to the city from the large agricultural district southeast of the Eastern Branch of the Potomac. The condition of the wood-work is such as to demand immediate attention, and an appropriation is earnestly recommended for it.

Financial statement for fiscal year ending June 30, 1885.

Title of appropriation.	Available at beginning of fiscal year.	Appropriated by general deficiency act approved March 3, 1885.	Expended and pledged.
Improvement and care of public grounds	$64, 500 00	$7, 000 00	$69, 812 16
Repairs, fuel, &c., Executive Mansion	19, 000 00	10, 500 00	28, 496 89
Lighting, &c., Executive Mansion, &c	15, 000 00	....	14, 941 07
Repairs to water-pipes and fire-plugs	2, 500 00	....	2, 462 02
Telegraph to connect the Capitol with the Departments and Government Printing Office	1, 230 00	....	1, 250 00
Constructing, repairing, and maintaining bridges, District of Columbia	2, 000 00	....	1, 986 86
Salaries of employés, Public Buildings and Grounds, under Chief Engineer	43, 340 00	....	43, 182 17
Rent of office, Public Buildings and Grounds, under Chief Engineer	900 00	....	900 00
Contingent expenses, Public Buildings and Grounds, under Chief Engineer	500 00	....	498 00
Improvement and care of public grounds, 1885-'86 (act March 3, 1885)*	2, 000 00	....	1, 789 20
Pedestal for statue of the late President James A. Garfield (act July 7, 1884)	30, 000 00	....	....
Unveiling statue of Rear-Admiral Du Pont (act July 7, 1884)	500 00	....	495 67

* Not available until March 3, 1885.

Although I have been in charge of this office but two months, I cannot close without bearing testimony to the faithful, energetic, and intelligent manner in which Mr. E. F. Concklin, overseer and chief clerk, and Mr. George F. Brown, public gardener, have performed the various and important duties intrusted to their charge.

I am, general, very respectfully, your obedient servant,

JOHN M. WILSON,
Lieut. Col. of Engineers, Colonel U. S. A.

To the CHIEF OF ENGINEERS, U. S. A.

APPENDIX Y Y.

ISSUE OF PUBLISHED CHARTS OF THE NORTHERN AND NORTHWESTERN LAKES.

ANNUAL REPORT OF LIEUTENANT-COLONEL O. M. POE, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 16, 1885.

SIR: I have the honor to transmit herewith my annual report on the "issue of the published charts of the northern and northwestern lakes" for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

O. M. POE,
Lieutenant-Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

The issue of the charts to registered vessels has continued during the year in accordance with regulations; also their sale at a fixed price (to cover cost of paper and printing), to any who desired to purchase.

The following table shows the extent of this business:

Table showing the issue of charts of the northern and northwestern lakes during the fiscal year ending June 30, 1885.

Description.	Number.	Total.
Charts on hand July 1, 1884	2,379	
Charts received during the year	6,725	
		9,104
Charts issued to vessels, &c	4,258	
Charts sold at 30 cents each	828	
		5,086
Charts on hand July 1, 1885	....	4,018

The sum of $248.40 was turned into the Treasury from sale of 828 charts, at 30 cents each.

Total number of charts issued to July 1, 1884	132,677
Issued between July 1, 1884, and July 1, 1885	5,086
Total issued to July 1, 1885	137,763

Estimate of funds for survey of northern and northwestern lakes for the fiscal year ending June 30, 1887.

For printing and issuing charts for the use of navigators, and electrotyping copper plates for chart printing	$2,000

APPENDIX Z Z.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF TEXAS.

REPORT OF MAJOR W. R. LIVERMORE, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

HEADQUARTERS DEPARTMENT OF TEXAS,
OFFICE ENGINEER OFFICER,
San Antonio, Tex., September 1, 1885.

GENERAL: I have the honor to submit the following report of operations in the Department of Texas for the year ending June 30, 1885.

The months of July and August were occupied in completing a topographical plat of surveys made during the preceding years. This plat covered an area of about fifty thousand square miles, thirty thousand of which were surveyed in 1883, and the remainder taken from the results of previous years and reports of scouts.

Before starting upon this expedition of 1883, I had made application for the necessary instruments to measure the primary triangulation, but did not succeed in getting them, and was therefore compelled to use inferior ones, designed for rough topographical work, imperfectly graduated, and of too little optical power to show the stations, which were sometimes more than one hundred miles distant; hence the topographical plat was based upon a number of tertiary triangulations, which often had to be extended over distances altogether disproportionate to the length of the bases and depended upon the mountain summits, not always well defined, to indicate the trigonometrical points.

This topographical work was so elaborate and so extensive that it was deemed advisable to complete the primary triangulation for which the stations had already been built and the angles measured with inferior instruments.

In July, 1884, I received from the engineer depot suitable instruments for this kind of work, viz, one secondary-base apparatus, one Troughton & Simms theodolite, 14-inch limb, and one Gambey theodolite, 6-inch limb.

After explaining the matter to the department commander, the following order was issued:

[Special Orders No. 109.]

HEADQUARTERS DEPARTMENT OF TEXAS,
San Antonio, Tex., August 23, 1884.

* * * * * * *

II. An expedition to complete the primary triangulation and latitude determinations of the country west of the Rio Pecos, Texas, and to obtain general knowledge of that region, will be organized and proceed so soon as proper arrangements shall have been completed. The duties will cease not later than December 10 next.

Maj. W. R. Livermore, Corps of Engineers, chief engineer officer of the Department, will command; he will proceed to Fort Davis, Texas, to complete the organization. The following officers and enlisted men will report, as indicated, to Major Livermore, on dates to be fixed by him: Second Lieuts. E. B. Ives, Nineteenth Infantry, and Leighton Finley, Tenth Cavalry, at Fort Davis, Texas. Second Lieut. W. F. Flynn, Eighth Cavalry, at San Antonio, Texas.

* * * * * * *

The commanding officer, Fort Davis, will detail one non-commissioned officer and five privates of cavalry, fully mounted and equipped, and, in addition, one non-commissioned officer and five privates of infantry, to be reported to Major Livermore, on his arrival at that post.

The commanding officer, Fort Clark, Texas, will detail six Seminole Negro-Indian scouts and forward them as may be indicated by Major Livermore.

* * * * * * *

By order of Brigadier-General Stanley.

THOMAS M. VINCENT,
Assistant Adjutant-General.

In compliance with the above order the expedition left Fort Davis on the 13th of September. The transportatation consisted of two army wagons, one escort-wagon, one spring-wagon, two instrument-carts, six pack-mules and four saddle-horses.

A supply camp was permanently established near Marfa.

On the 19th of September, accompanied by Lieutenant Ives, I left the main camp and occupied station Limpia, remaining there until the 26th. In the mean time Lieutenant Finley, with Topographical Assistants Rostock and von Thaden, were occupied in measuring the base line.

On my return to Marfa the parties were divided up as follows: Lieutenants Ives and Finley proceeded on October 2, via Murphyville, to Mount Ord, Santiago, Tarlinga, and San Jacinto Peaks, completing the secondary triangulation and topography of that region November 14.

Meanwhile with Lieutenant Flynn I occupied Cathedral and Baldy peaks and some of the base stations.

Topographical Assistants Rostock and von Thaden measured the base line, occupied the neighboring stations, and took observations for latitude and azimuth at Station E, near Rancheria.

On the 14th of November, with Topographical Assistant von Thaden, I went to Davis Ranch, where we arrived on the 15th. Here we met Lieutenant Ives, and the parties were divided up as follows: Assisted by Lieutenant Ives I made a survey of the country between Davis Ranch and Presidio del Norte, and connected the triangulation with an astronomical point established by the boundary survey of 1852.* Lieutenant Finley, with Topographical Assistant von Thaden, occupied Station Chinati, and Lieutenant Flynn, with Topographical Assistant Rostock, continued work on the base station.

I returned to Marfa from Presidio del Norte November 25, leaving Lieutenant Ives to survey south of San Jacinto and east of Presidio del Norte. Topographical Assistant von Thaden joined Lieutenant Ives after the completion of the work on Chinati summit, and Lieutenant Finley returned to Marfa on the 27th.

November 30, with Lieutenant Flynn, I went by the Southern Pacific Railroad to El Paso, and by the Texas Pacific Railroad from El Paso to San Martin Spring, occupying points along the route necessary to complete the triangulation, and to fill in the topography of such parts of the country as were not surveyed by previous expeditions.

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*See Report on the United States and Mexican Boundary, Vol. I, page 193.

While at El Paso the triangulation was roughly connected with an astronomical station located at Fort Bliss by Captain Wheeler in 1878.*

In the mean time Lieutenant Finley and Topographical Assistant Rostock occupied Sierra Blanca and Eagle Mountain.

The parties arrived at Fort Davis December 10, and the expedition was broken up on the same day.

I returned to San Antonio December 16, leaving Topographical Assistant Rostock and von Thaden to determine the longitude of Marfa; but, owing to the impossibility of completing the telegraphic connection, they were recalled December 28. On their return they occupied Tres Hermanos Peak December 31 and connected Maxon Spring railroad station with the triangulation on January 1, 1885.

A preliminary computation of the triangulation was made in the field, showing results which, in point of accuracy, would compare favorably with the best geodetic work on record, and upon this basis a final plot of the topography was commenced in February, and on a scale of 1 inch to 2 miles.

I was notified about this time that funds would be available for lithographing such maps as could be prepared before the end of the fiscal year. This is the first time for five years that any appropriation has been made for this office.

In order to obtain the full benefit of this appropriation, sketches of the whole area, so far as replotted, were sent to Washington on the 20th of June, together with a military map of Western Texas, and one of Southwestern Texas and the adjacent part of Mexico.

The military map of Western Texas was prepared during the spring of 1884, in hopes that it might have been lithographed in that year. The results of the survey of 1883 had not then been plotted.

The map of Southwestern Texas and of the adjacent part of Mexico was prepared in 1880, from the results of odometer surveys made by me in 1879, and from reports of scouts and a compilation of maps previously published.

The military maps of Western and Southwestern Texas are to be published on a scale of 1 inch to 16 miles; the topographical sketches of the country west of the Pecos, on a scale of 1 inch to 4 miles.

Two copies of the map of Western Texas accompany this report. "A" shows the principal lines of the primary triangulation as already completed. "B" serves as an index map for the topographical sheets, and shows the routes followed by the expeditions of 1880, 1881, 1883, and 1884.

The sheets above referred to, that were sent to Washington last June, are those numbered 1, 2, 5, 6, 7, 10, 11, and 15. It will be seen that they cover all the country west of the Pecos, excepting a small strip lying along this river, which has since been mapped by combining our own surveys with some obtained from the Land Office and from the New York and Texas Land Company.

The officers and topographical assistants are entitled to great credit for the manner in which they carried out this work.

Lieutenant Ives had charge of an independent party throughout the season, and did good work in secondary triangulation, topography, and photography. Lieutenant Flynn showed unusual capacity as quartermaster of the expedition as well as in pirmary triangulation. Lieutenant Finley rendered valuable assistance to Lieutenant Ives, and at the end of the season took charge of a party of his own. Mr. Rostock successfully performed the astronomical work required of him, and his work on the primary triangulation could not have been surpassed.

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* See Annual Report of the Chief of Engineers 1879, Appendix O O, page 2058.

Topographical Assistant von Thaden aided Lieutenant Ives in topographical work, and Mr. Rostock in primary triangulation. Private Joseph Hampl, Troop L, Eighth Cavalry, was detailed to join the expedition on the 1st of October, and was employed first as recorder and afterwards as observer. He did good work in primary triangulation and topography.

Thus the expedition of 1884 completed the work which had been projected the year before, as stated in my last annual report.

The topographical sketches are copied from the office plot on a scale of an inch to 2 miles, which shows most of the topography, especially of the mountains, as accurately as it could be plotted from that scale; but in some cases the meanderings of the streams have been taken from the records of the Land Office.

A great many altitudes have been computed from vertical angles, and the triangulation appears to be as good as can be required. The quadrilaterals and independent systems of triangles show a probable error of less than $\frac{1}{80000}$. If more assistants were available for office work, it might be advisable to extend the computations and perfect the drawings. This, however, could be done at any time, and it is believed that the work is now in good condition to preserve the results of the survey for future reference.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

THE CHIEF OF ENGINEERS,
Washington, D. C.

APPENDIX A A A.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF THE PLATTE.

REPORT OF LIEUTENANT DAN C. KINGMAN, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

HEADQUARTERS DEPARTMENT OF THE PLATTE,
ENGINEER OFFICE (IN THE FIELD),
Mammoth Hot Springs, Wyo., September 9, 1885.

GENERAL: I have the honor to submit, as engineer officer of this military department, the following report for the fiscal year ending June 30, 1885.

The field work that has been done under my direction has been the construction of roads and bridges in the Yellowstone National Park. Of this work a separate report has been rendered to cover the working season of 1884, and as soon as the present season closes a report will be submitted to cover the rest of the year.

In July, 1884, I organized a party at Fort Fred Steele, Wyo., and made a reconnaissance northward from Rawlins to Fort McKinney, Wyo., a distance of about 220 miles. The object of this reconnaissance was to ascertain if a suitable wagon-route between these two points could be found. The work occupied about three weeks, and a report of it was submitted to the department commander August 5, 1884. This comprises all the field work done under my direction during the year.

The work in the office has consisted in making drawings on linen of the plans of all the posts, and of the plots of all the military reservations in the department excepting Fort D. A. Russell, Wyo., which was in the course of reconstruction, and in regard to which I could obtain no accurate information. From each of these drawings from seventeen to twenty blue prints were made. Printed descriptions of each post and reservation were also prepared. Ten copies of each blue print and of each legend were, in compliance with instructions, forwarded to division headquarters, and three copies were furnished to the Chief of Engineers. The commanding officer of each military post was also furnished with a set pertaining to his post. The remaining copies were retained for use at department headquarters.

I also caused the notes of the reconnaissance heretofore described to be plotted, and prepared an itinerary of the route.

I also caused to be prepared and placed in the hands of the printer the manuscript for a new edition of the tables of distances and itineraries of routes in the Department of the Platte.

I have also commenced the construction of a map of the Department of the Platte, upon a scale suitable for publication. Good progress has been made upon this work.

In the month of March, 1885, I visited Sioux Falls, Iowa, as a member of a commission to examine and report upon the United States penitentiary building at that place, in compliance with a letter of the Adjutant-General of the Army, February 18, 1885.

As heretofore the office has been without funds during the entire year, and many of the office supplies have been exhausted. From time to time drawing and photographic materials, in limited quantities, have, by direction of the department commander, been furnished by the Quartermaster's Department for current use.

Maps, itineraries, topographical note-books, and surveying and reconnoitering instruments have been issued to officers of the department as requested, and other matter of routine pertaining to the engineer office at a department headquarters have been regularly attended to.

Topographical Assistant Robert Stone has been on duty throughout the year, and Topographical Assistant Henry Kehl was on duty until May 12, when he was honorably discharged the service at his own request.

Very respectfully, your obedient servant,

DAN C. KINGMAN,
First Lieutenant of Engineers.

The CHIEF OF ENGINEERS,
U. S. Army, Washington, D. C.

APPENDIX B B B.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF DAKOTA.

REPORT OF LIEUTENANT JOHN BIDDLE, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

HEADQUARTERS DEPARTMENT OF DAKOTA,
OFFICE CHIEF ENGINEER OFFICER,
Fort Snelling, Minn., July 13, 1885.

GENERAL: I have the honor to submit the following report of the operations carried on in this office during the fiscal year ending June 30, 1885.

PERSONNEL.

Private Edward B. Summers, topographical assistant, has been employed throughout the year. Private Albert W. Turner, topographical assistant, was discharged at his own request on September 30, 1884. Private Ernest Rakowiez, topographical assistant, has been on duty since September 30, 1884. First-class Private Herman F. Strebe, Company A, Battalion of Engineers, has been on duty throughout the year. Two privates from the Twenty-fifth Infantry have been on daily duty in the office.

These assistants all deserve credit for their attention to duty and for their valuable services.

WORK PERFORMED.

Field work.—The boundary line of the Yankton Indian Reservation was resurveyed and marked by this office during July and August, 1884. The escort was furnished from Fort Randall, Dak. Report and map of work have been submitted.

The boundary lines of the following military reservations were resurveyed and marked by this office during the summer and fall of 1884: Fort Meade, Dak., Fort Sully, Dak., and Fort Abraham Lincoln, Dak. Report and maps were submitted.

The boundary line of Fort Pembina military reservation, Dakota, was resurveyed during May, 1885. Report not yet submitted. In all this work the transit was used by Topographical Assistant E. B. Summers, under my supervision. The boundary line of Fort Randall (Dak.) military reservation was resurveyed and marked by First Lieut. P. F. Davis, Fifteenth Infantry, and report submitted with plat.

The post and reservation of Fort Snelling is being resurveyed and new map prepared.

The commanding officers of all the posts in the department of which there were no reliable maps have caused such surveys as were necessary to be made, and the maps to be drawn.

First Lieut. C. A. Varnum, Seventh Cavalry, submitted a report of a march made by him from Fort Meade, Dak., to the Northern Pacific Railroad and return by two routes. The object was to determine the feasibility of transporting stores from the Northern Pacific Railroad to Fort Meade.

First Lieut. J. P. Thompson submitted a report of a march through the country north of Flathead Lake, Mont., made to investigate the complaints of the settlers against the Indians of that vicinity.

Various scouts have, during this spring, been made in the northern part of the department, and reports submitted. Likewise reports of country passed over on hunting trips have been received.

Considerable work has been done on this reservation at the rifle range, setting out stakes for leveling, determining lines for the laying of water-pipes, &c.

OFFICE WORK.

A new map of the department is in course of drawing, also a large map of the Fort Snelling reservation.

Descriptions of all the military posts in the department have been compiled from data furnished by the post commanders, and plats of the post and reservations, of a size to be bound, with the descriptions, have been prepared to accompany them. Various maps of the reservations surveyed, plans for the quartermaster's department, copies of scouts, &c., have been drawn during the year. Blue-print copies of the department map, and of such other maps as were on hand, have been sent to all who desired them. Other maps, sent from the Chief of Engineers' Office, have been mounted and distributed.

RECOMMENDATIONS.

The principal need of this department is money for the repair of instruments and to obtain material. For these purposes I renew the recommendation made in the Report of 1884, that $300 be appropriated to be used in this office.

Very respectfully, your obedient servant,

JOHN BIDDLE,
First Lieutenant, Corps of Engineers.

The CHIEF OF ENGINEERS,
Washington, D. C.

APPENDIX C C C.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF CALIFORNIA.

REPORT OF LIEUTENANT THOMAS L. CASEY, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

ENGINEER OFFICE,
HEADQUARTERS DIVISION OF THE PACIFIC,
Presidio of San Francisco, Cal., July 20, 1885.

SIR: I have the honor to transmit herewith a report of operations in this office for the fiscal year ending June 30, 1885.

Engineer officer in charge from July 1, 1884, to October 1, 1884, Maj. W. A. Jones, Corps of Engineers; from October 1, 1884, to February 1, 1885, Maj. M. B. Adams, Corps of Engineers; from the latter date until the close of the fiscal year the office has been in my charge.

The clerical force has consisted of Topographical Assistants H. H. Price and Clement Winstanley.

At the request of the governor of California, Maj. W. A Jones was ordered to the Needles and Fort Yuma, Cal., for the purpose of making observations for the determination of the latitude and longitude of those points. The reduction of these observations was begun by Maj. M. B. Adams, and is in part completed.

This office is in constant communication with the various railroad companies, who from time to time give information concerning changes in their respective systems. These changes are recorded upon a map kept for that purpose, which is to be forwarded to the Chief of Engineers when sufficiently complete.

As inspector of rifle practice of the Department of California per paragraph 2, General Order No. 1, headquarters Department of California, and as itinerary officer of Light Battery K, First Artillery, on its annual march of instruction, per Special Order No. 33, Department of California, March 27, 1885, I have been personally enabled to gather several additional items, which will aid in the preparation of the above-mentioned map. The regions inspected under the first head are those about San Diego and Fort Gaston, and under the latter an important section of country embraced by Alameda, Contra Costa, Napa, Sonoma, Mendocino, and Marin counties. Meteorological observations were also taken at stated hours of the day during the march of instruction.

Operations have also been directed to the following ends:

Surveys for military purposes.

Photographing military implements and materials.

Preparation of maps for preservation.

Copying, enlarging, and reducing maps and drawings by photography.

It is earnestly recommended that $2,500 be appropriated for the ensuing fiscal year for repair of instruments purchase of drawing material, &c. This is the minimum amount which can be appropriately employed for these purposes, and is absolutely requisite in order that the office may be maintained in a proper state of efficiency.

It is also recommended that an allowance of $800 be granted for the purchase of a copying camera, lens, and copying table, it being impossible at the present time to make map copies which are required in the division in a satisfactory manner.

Respectfully submitted.

THOS. L. CASEY,
First Lieutenant of Engineers.

The CHIEF OF ENGINEERS, U. S. A.,
Washington, D. C.

APPENDIX D D D.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF ARIZONA.

REPORT OF LIEUTENANT THEODORE A. BINGHAM, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

HEADQUARTERS DEPARTMENT OF ARIZONA,
OFFICE OF THE CHIEF ENGINEER,
Whipple Barracks, Ariz., June 30, 1885.

SIR: I have the honor to submit the following report of the work of this office for the fiscal year ending to-day.

PERSONNEL.

Topographical Assistants E. D. Williams and Oskar Huber have been on duty throughout the year.

FIELD WORK.

During July, 1884, the boundaries of the timber reservation of this post were re-run.

This land has since been returned to the public domain (General Order No. 80, of 1884, Adjutant-General's Office).

October 13, 1884, to January 17, 1885, the eastern boundary of the White Mountain Indian Reserve was laid out. The two topographical assistants accompanied me, and Company B, First Infantry, under its captain, W. E. Dougherty, formed the escort.

We were greatly embarrassed toward the end by heavy snow-storms and accidents to men at work, resulting from the extreme roughness of the country. The line was run south from the White Mountains, and connected most satisfactorily with the southeastern corner of this reservation as established by the Land Office survey in 1883 of the southern boundary.

Returned to my station by way of all the posts of the department lying south of Whipple, in order to be able to discuss intelligently any question regarding them which might be referred to this office.

February 17 to March 17, 1885.—Absent from station at Fort Bowie to assist in laying out and constructing a water-supply system.

No maps of scouts or hunts have been sent to this office during the year.

OFFICE WORK.

Completion, printing, and distribution of maps of all the boundaries of the White Mountain Indian Reservation. These were made on a scale (½ mile to 1 inch) large enough to serve any discussion of boundary between Indians and settlers.

Road maps of Territory redrawn, printed, and distributed.

Skeleton map of Mexico, showing existing and proposed railroads, made with side sketches showing approaches to the city of Mexico and the roads between it and Vera Cruz.

A new map of the entire Territory has been completed and forwarded to the Chief of Engineers. It contains all the information, such as scouts, &c., on file in this office, up to June 30, 1885. This map was greatly needed, and will, it is thought, be found very satisfactory. The scale is large enough (8 miles to 1 inch) to show all the roads, trails, and water for camping, and will thus do away with the necessity which has always heretofore existed for separate maps on a large scale for use on marches, and consequently saves much labor in blue printing and mounting on linen.

The so-called "official" map of Riecken and Eckhoff, published in 1880, has heretofore been the "latest," but was imperfect in many particulars.

There has been a great demand during the year by officers serving in this department for maps of the seats of war in Canada, Afghanistan, and the Sûdan. Considerable work was done in mounting and distributing these in addition to the maps of the Territory called for and of the United States west of the Mississippi River.

Maps mounted during the year 57, comprising 112 sheets; 75 printed during the year, 155 sheets.

CONCLUSION.

Two important works were waiting to be done when I took charge of this office two years ago, viz, the laying out of the boundaries of the White Mountain Indian Reservation and a new map of the Territory. Both have been finished.

As no money has been for years or is now available for surveys in this Territory or for any other work, and as all the information in the office has been embodied in the new map just completed, the future duties of this office will be very light unless money can be obtained.

I respectfully suggest that the next work should be telegraphic determination of longitude and the measurment of a base line on which to found a triangulation.

I also respectfully repeat my request of last year for a camera and photographic plant for use in connection with surveys.

I earnestly request your favorable recommendation of the following sums for use by this office during the fiscal year ending June 30, 1886:

For telegraphic determination of longitudes, for measuring a base line and making a beginning of an accurate survey of the Territory	$3,000
For drawing-paper, pencils, &c., for ordinary expenses of office work	200
For camera, dry plates, chemicals, &c., for field use	150
One year's photographic supply	50
	3,400

My thanks are due the Quartermaster Department of these and division headquarters for assistance during the year, without which even the routine work of the office could not have been carried on.

It is proposed during the coming year to furnish each post in the department with one mounted copy each of the map of the "United States west of the Mississippi River" and of the new map of the Territory, and also to provide each officer with a pocket mounted map of the Territory for use in the field. Also to complete, if possible, an outline description of the past and present posts of the department, with history, plans, &c.

Very respectfully, your obedient servant,

THEO. A. BINGHAM,
First Lieutenant of Engineers,
Engineer Officer, Department of Arizona.

The CHIEF OF ENGINEERS, U. S. A.

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